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ENVIRONMENTAL ASSESSMENT FOR BOSTON HARBOR MAINTENANCE DREDGING--ETC(U)

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ENVIRONMENTAL ASSESSMENT

MAINTENANCE DREDGING
BOSTON HARBOR
BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

DECEMBER 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A120053	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) ENVIRONMENTAL ASSESSMENT FOR BOSTON HARBOR MAINTENANCE DREDGING, BOSTON, MASS.		5. TYPE OF REPORT & PERIOD COVERED ENVIRONMENTAL ASSESSMENT
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U. S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDPL-I 424 TRAPELO ROAD, WALTHAM, MA 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE December 1981
		13. NUMBER OF PAGES 50
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Mystic River
Boston Harbor - Dredging
Dredging - Chelsea River
Dredged Material Disposal
Disposal Sites
Shoal Material

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Maintenance dredging is proposed in the Mystic and Chelsea Rivers and in President Roads Anchorage. Impacts during dredging and disposal would include a temporary increase in turbidity and minor release of certain contaminates. No significant effect upon the water quality in the vicinity. Bioassay tests indicate disposal would not cause any acute chemical impacts to organisms.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

FINDING OF NO SIGNIFICANT IMPACT

The Environmental Assessment for this project is attached and describes the proposed action, need for the project, alternatives, affected environment and environmental consequences.

Implementation of the proposed project will not require a significant commitment of physical, natural or human resources. Coordination among all parties during the planning process has resulted in the recommended maintenance proposal. The impacts have been outlined in the assessment and are summarized below.

Impacts during dredging and disposal operations would include a temporary increase in turbidity and a minor release of certain contaminants. These impacts would not significantly affect the water quality or organisms in the vicinity of the activities. The operation would involve displacement of the harbor sediments which would remove bottom-associated invertebrates from the dredge sites and bury those associated with the disposal site. Recolonization would occur in the project area soon after operations ceased. Bioassay tests indicated that disposal of the sediments would not cause any acute chemical impacts to organisms in the vicinity of the dump site. Bioaccumulation tests exhibited potential uptake of certain sediment contaminants; however, the relative tissue levels were well within Federal Food and Drug Administration's action levels for shellfish and fish or were within the range of baseline tissue levels of most organisms. Field studies of other areas have shown accumulation associated with disposal operations to be temporary and would decrease after operations were completed. Federally listed endangered and threatened species which use the general area where the dump site is located would avoid the operations. Disposal activities would not jeopardize continued existence of the endangered populations in the area or their food species.

There does not appear to be any remaining major environmental problem, conflict or disagreement in implementing the proposed work. I have determined that implementation of the proposed action will not have a significant impact on the human environment.

10 December 1981
Date

C. E. Edgar III
C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

ENVIRONMENTAL ASSESSMENT

FOR

BOSTON HARBOR MAINTENANCE DREDGING

BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

DECEMBER 1981

TABLE OF CONTENTS

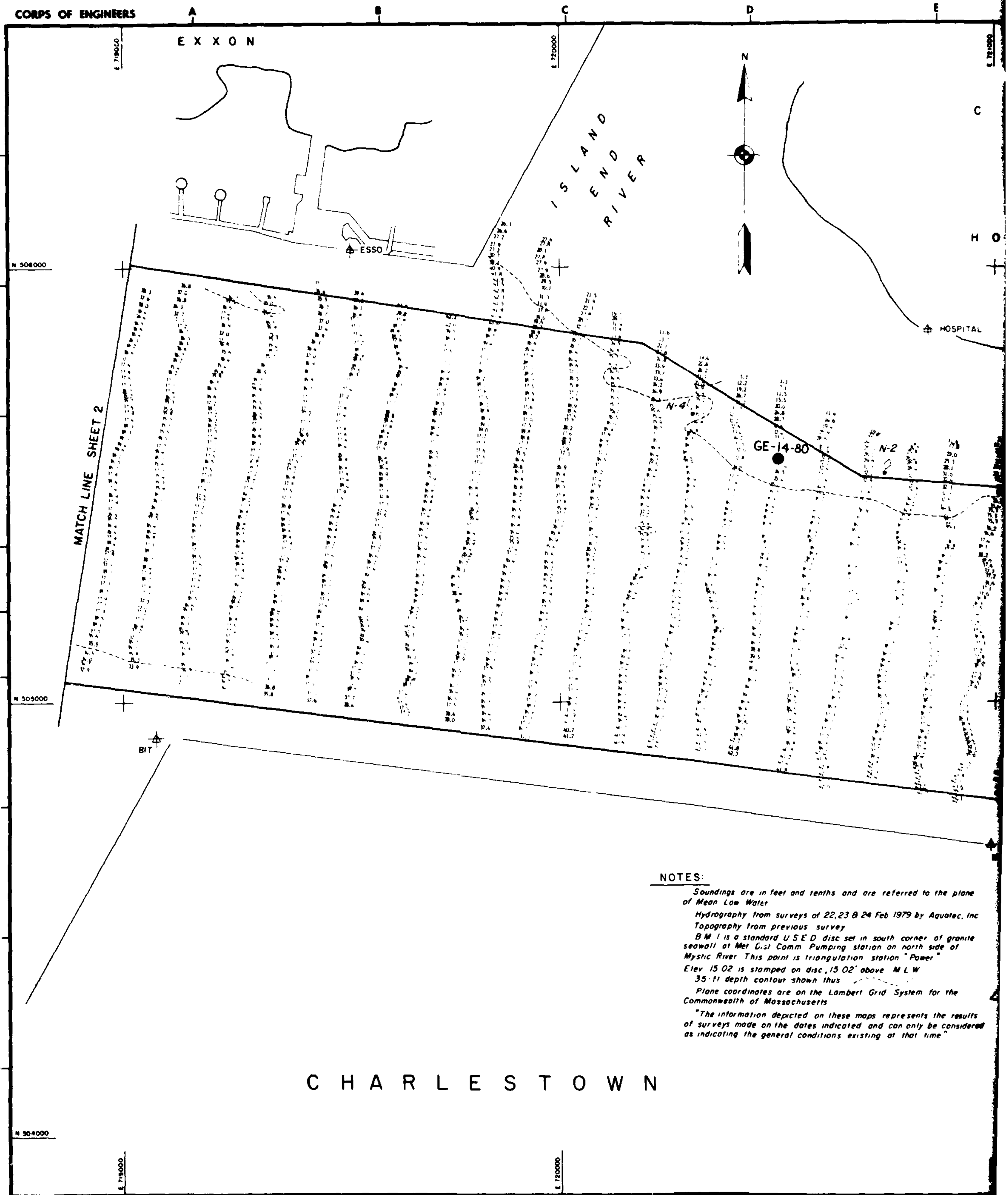
INTRODUCTION

This Environmental Assessment discusses the need for and the environmental impacts of the proposed maintenance dredging of the Federal navigation channels in the Mystic and Chelsea Rivers and the anchorage at President Roads. This action will involve removal of approximately 425,000 cubic yards (c.y.) of harbor sediments for ocean disposal. The estimate is based on a 1978 survey. Major areas of concern include, impacts to water quality and aquatic resources at the dredging and disposal sites. The assessment was partially based on an Environmental Report on the Maintenance Dredging of Boston Harbor prepared for the Corps of Engineers, New England Division by Jason M. Cortell and Associates, Inc. (1977).

I. PROJECT DESCRIPTION

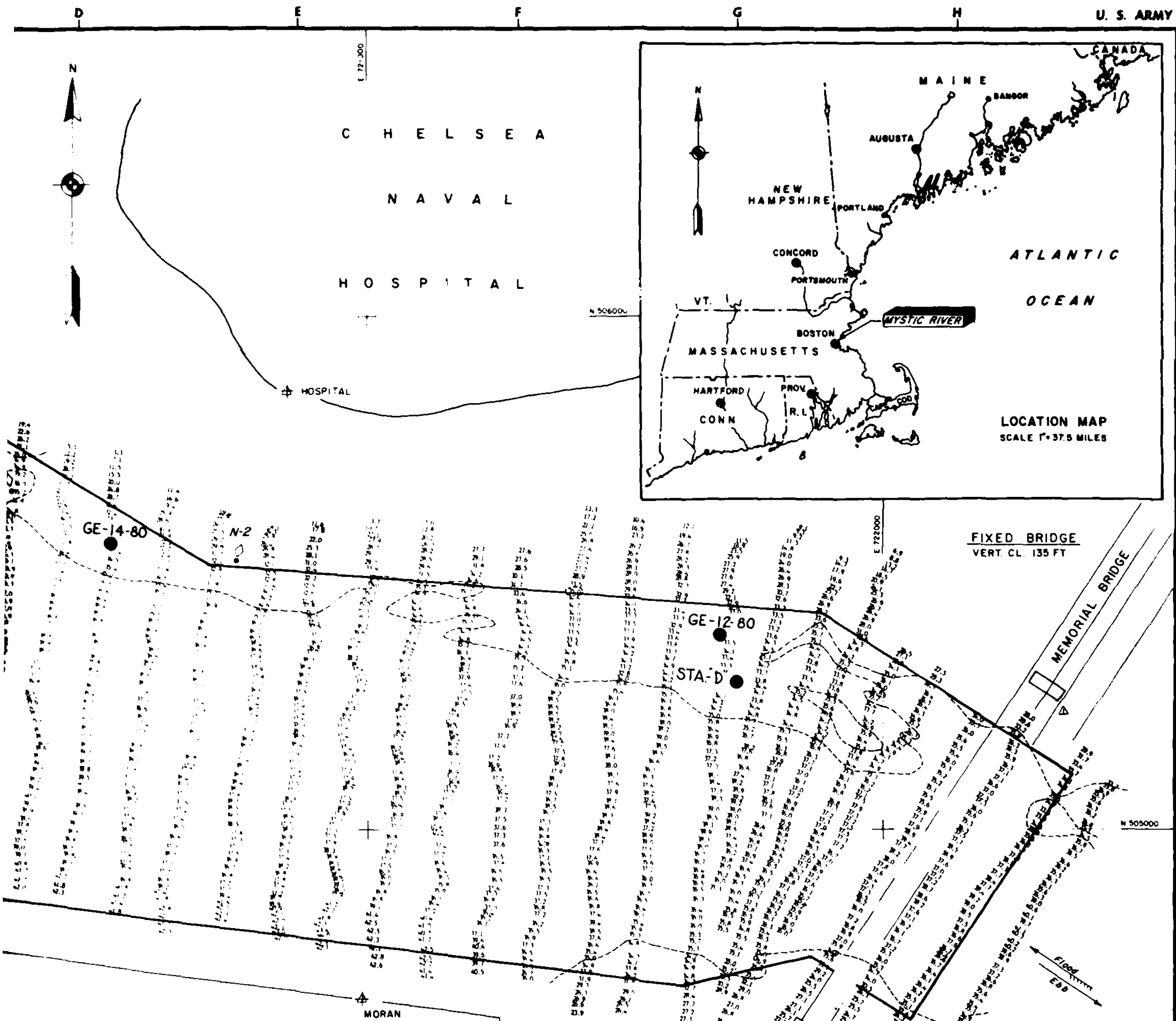
Maintenance dredging is proposed in the Mystic and Chelsea Rivers and in President Roads Anchorage. The Federally authorized dimensions for these projects are: Mystic River Channel - 35 feet deep with widths varying from 600 feet to 1,000 feet, extending approximately one mile from the confluence of the Mystic and Chelsea Rivers to a point just downstream of the Alford Street Bridge (Figs. 1 and 2); Chelsea River Channel - 35 feet deep with widths varying from 225 feet to 250 feet, extending approximately 1-1/2 miles upstream from the confluence of the Mystic and Chelsea Rivers; (Figs. 3, 4, and 5) and President Roads Anchorage in the outer harbor - 40 feet deep for an area approximately 2,000 feet by 5,500 feet (Fig. 6).

Maintenance dredging within the limits of these Federal projects would be accomplished with a clamshell dredge, which would place the sediment in scows that would be towed to the Foul Area Ocean Disposal site in outer Massachusetts Bay and point dumped at a buoy. The work would start in the spring of 1982 and continue into the fall. The contractor would be permitted to work 24 hours per day, but actual work shifts would depend on the capability of the approved low bidder. The typical contractor would work two, ten-hour shifts. Records of progress on completed jobs similar to the proposed work indicate that a maximum of six scows per day could be brought to the dispsoal area. The average scow can hold 1,500 to 2,000 cubic yards. A more realistic estimate would be four scows per day with many days, perhaps as much as 20-25 percent of the contract period, when no scows would be towed because of weather problems.



CORPS OF ENGINEERS
A
B
C
D
E
EXXON
E 719000
E 720000
E 721000
N
ISLAND END RIVER
C
H O
ESSO
HOSPITAL
N 506000
N 505000
N 504000
1
2
3
4
5
6
7
8
MATCH LINE SHEET 2
N-4
GE-14-80
N-2
BIT
NOTES:
Soundings are in feet and tenths and are referred to the plane of Mean Low Water
Hydrography from surveys of 22,23 & 24 Feb 1979 by Aquatec, Inc
Topography from previous survey
B.M. 1 is a standard U.S.E.D. disc set in south corner of granite seawall at Met Dist Comm Pumping station on north side of Mystic River This point is triangulation station "Power"
Elev 15.02 is stamped on disc, 15.02' above M.L.W.
35-ft depth contour shown thus
Plane coordinates are on the Lambert Grid System for the Commonwealth of Massachusetts
"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"
CHARLESTOWN

1



[NOT]ES:

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Hydrography from surveys of 22, 23 & 24 Feb 1979 by Aquatec, Inc

Topography from previous survey

B.M. 1 is a standard U.S.E.D. disc set in south corner of granite seawall at Met Dist Comm Pumping station on north side of Mystic River. This point is triangulation station "Power". Elev 15.02 is stamped on disc, 15.02' above M.L.W.

35-ft depth contour shown thus

Plane coordinates are on the Lambert Grid System for the Commonwealth of Massachusetts

"The information depicted on these maps represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"

GRAPHIC SCALES

1" = 37.5 MI

25 0 25 50 75

SCALE IN FEET

100 0 100 200

REVISION	DATE	DESCRIPTION	BY
△	9/15/80	Approx location of pier bases of Mystic Tobin Bridge	DTC

AQUATEC, INC
SOUTH BURLINGTON, VT
ARCHITECT - ENGINEER

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

DR. BY NCR Jr | TR. BY BCM | CK. BY NCR Sr

SUBMITTED: ARCHITECT-ENGINEER

REVIEWED: CHIEF, ENGR. & S. C. SECTION

APPROVAL RECOMMENDED: CHIEF, DESIGN BRANCH

MYSTIC RIVER, MASS.

35 FOOT CHANNEL

CONDITION SURVEY

APPROVED: CHIEF, ENGINEERING DIVISION

DATE APRIL 1979

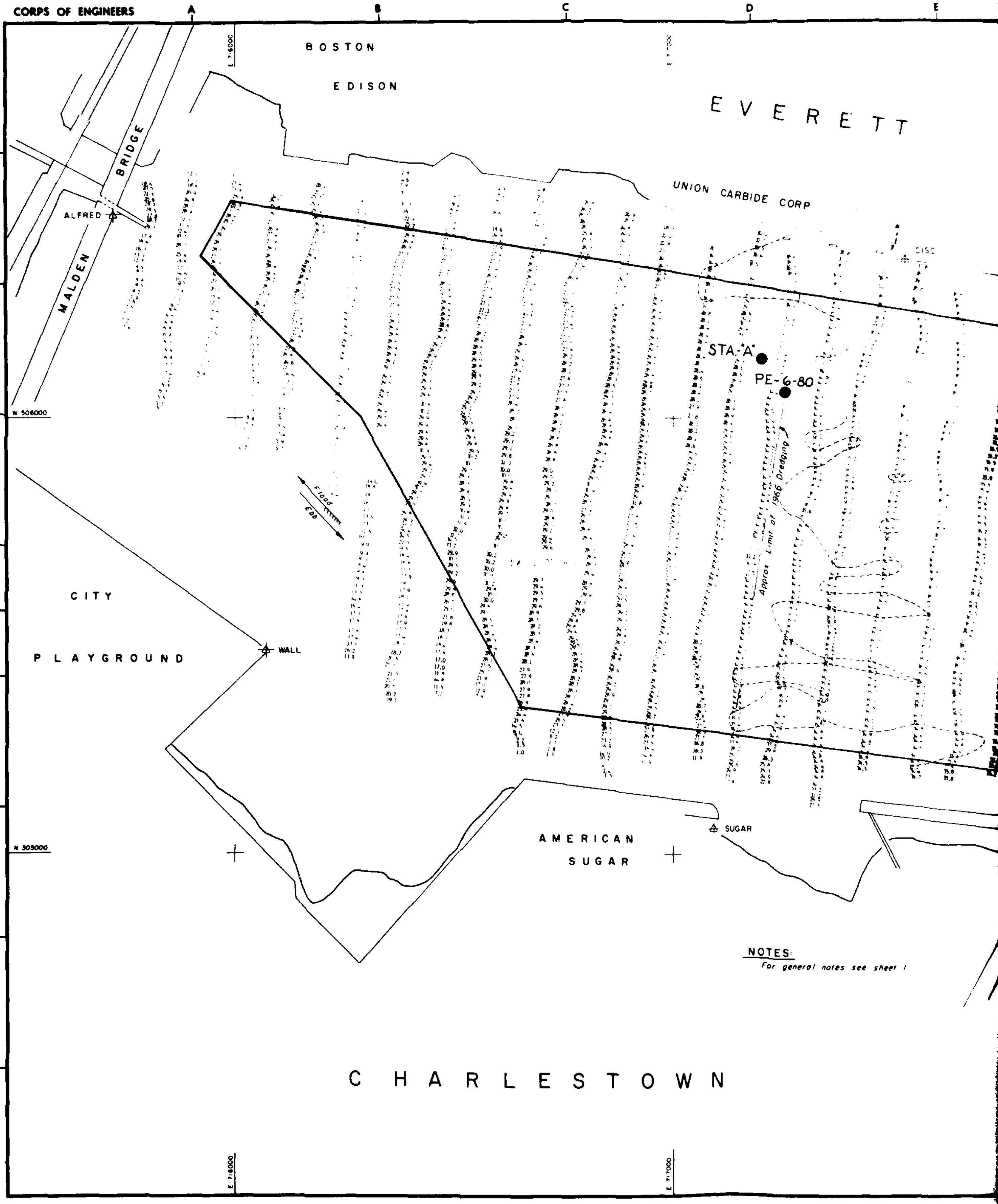
SCALE 1" = 100' | SPEC. NO. DACW 33

DRAWING NUMBER 400 Dr 50

SHEET 1 OF 2

FIGURE 1

2



CORPS OF ENGINEERS
A
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BOSTON
EDISON
EVERETT
UNION CARBIDE CORP
MALDEN
BRIDGE
ALFRED
STA. "A"
PE-6-80
Approx Limit of 1966 Dredging
Flood
Ebb
CITY
PLAYGROUND
WALL
AMERICAN
SUGAR
SUGAR
NOTES:
For general notes see sheet 1
CHARLESTOWN
N 506000
N 505000

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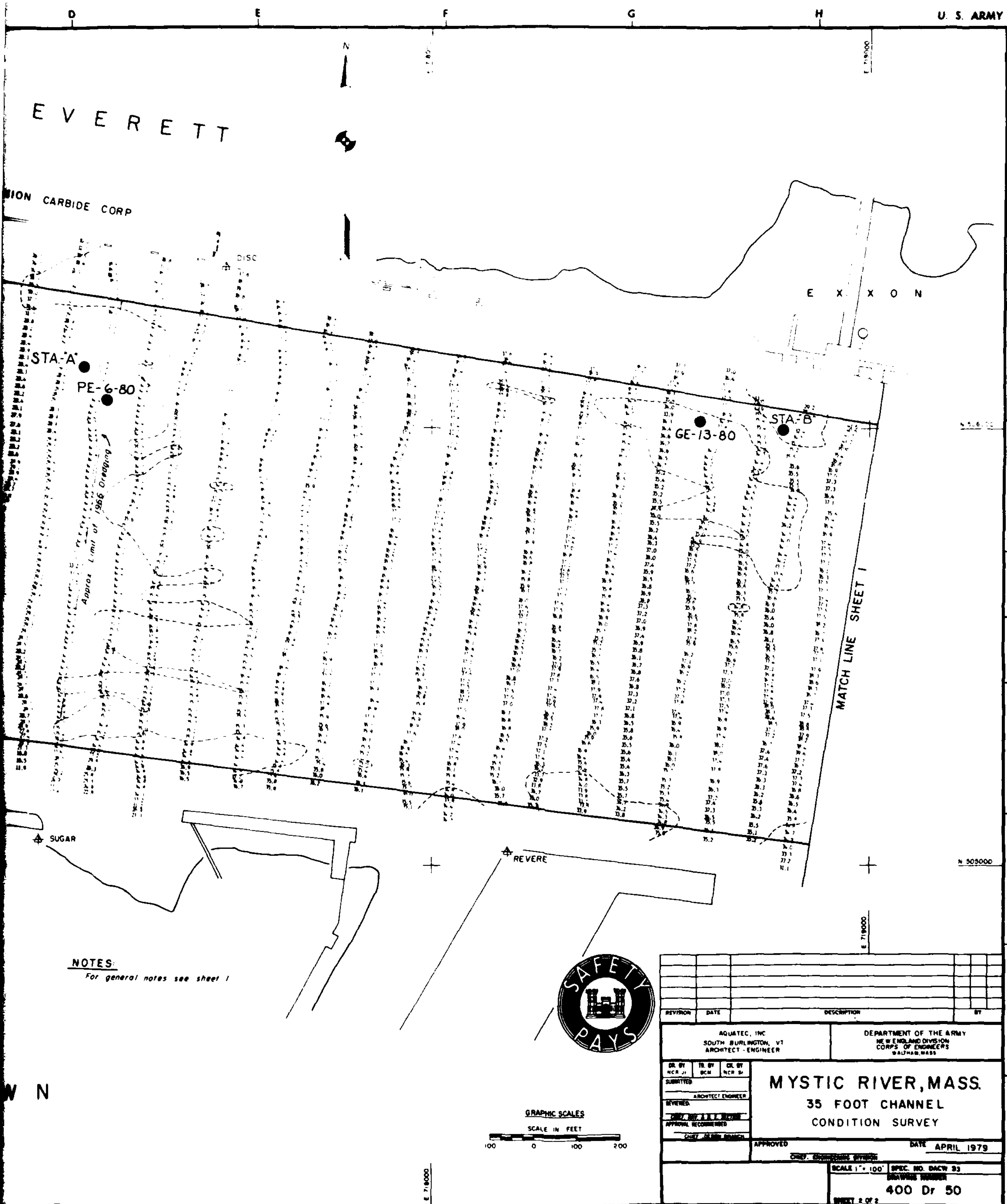
U. S. ARMY
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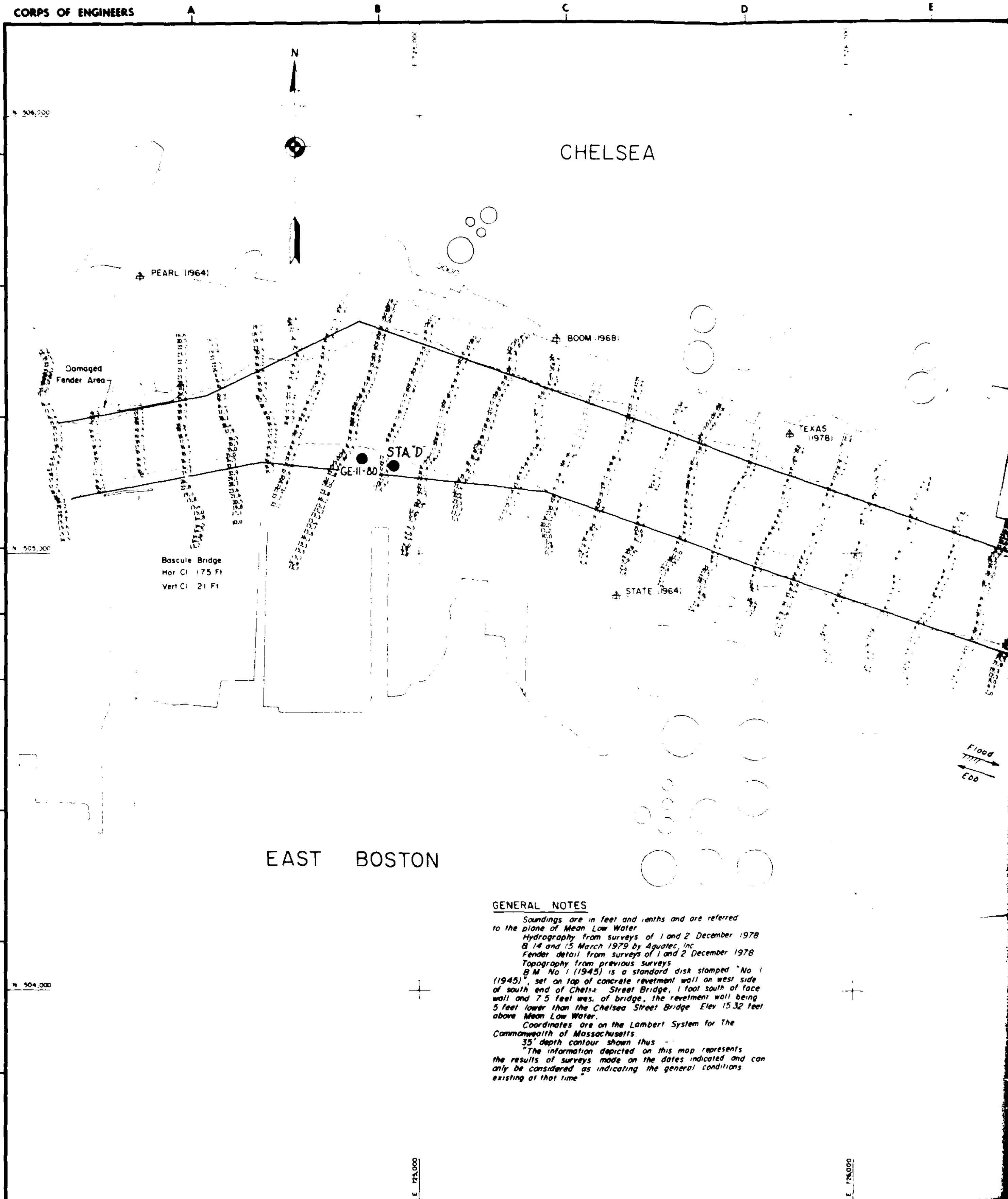
EVERETT
ION CARBIDE CORP
DISC
EXXON
STA. A
PE-6-80
GE-13-80
STA. B
Approx. Limit of 1966 Dredging
MATCH LINE SHEET I
SUGAR
REVERE
N 505000
E 719000
NOTES:
For general notes see sheet I
SAFETY PAYS
GRAPHIC SCALES
SCALE IN FEET
100 0 100 200
W N
REVISION
DATE
DESCRIPTION
BY
AQUATEC, INC
SOUTH BURLINGTON, VT
ARCHITECT - ENGINEER
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS
DR. BY NCR Jr
TR. BY BCM
CK. BY NCR Sr
SUBMITTED:
ARCHITECT ENGINEER
REVIEWED:
APPROVAL RECOMMENDED:
MYSTIC RIVER, MASS.
35 FOOT CHANNEL
CONDITION SURVEY
APPROVED
DATE APRIL 1979
SCALE 1" = 100'
SPEC. NO. DACW 33
DRAWING NUMBER
400 Dr 50
SHEET 2 OF 2

FIGURE 2

CORPS OF ENGINEERS



GENERAL NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Hydrography from surveys of 1 and 2 December 1978 & 14 and 15 March 1979 by Aquatec, Inc

Fender detail from surveys of 1 and 2 December 1978

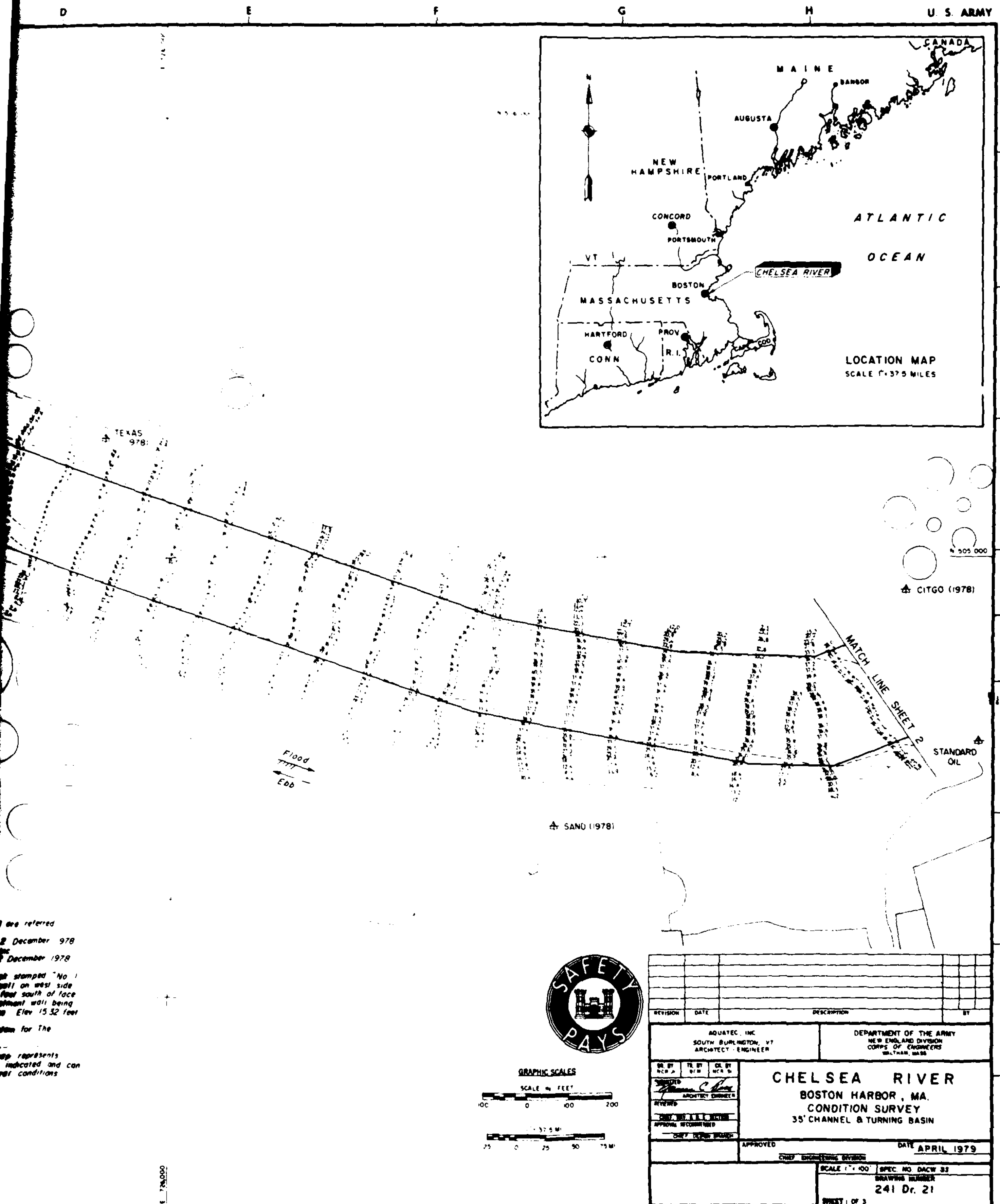
Topography from previous surveys

B M No 1 (1945) is a standard disk stamped "No 1 (1945)", set on top of concrete revetment wall on west side of south end of Chelsea Street Bridge, 1 foot south of face wall and 7 5 feet west of bridge, the revetment wall being 5 feet lower than the Chelsea Street Bridge Elev 15.32 feet above Mean Low Water.

Coordinates are on the Lambert System for The Commonwealth of Massachusetts.

35' depth contour shown thus - -

"The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"


D
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U. S. ARMY
CANADA
MAINE
BANGOR
AUGUSTA
NEW HAMPSHIRE
PORTLAND
CONCORD
PORTSMOUTH
ATLANTIC OCEAN
VT
CHELSEA RIVER
BOSTON
MASSACHUSETTS
HARTFORD
PROV
R.I.
CONN
LOCATION MAP
SCALE 1"=37.5 MILES
TEXAS 1978
N 505 000
CITGO (1978)
MATCH LINE SHEET 2
STANDARD OIL
Flood
Ebb
SAND (1978)
are referred
2 December 1978
December 1978
stamped "No 1
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Elev 15.32 feet
for The
represents
indicated and con
conditions
SAFETY PAYS
GRAPHIC SCALES
SCALE IN FEET
100 0 100 200
REVISION
DATE
DESCRIPTION
BY
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SOUTH BURLINGTON, VT
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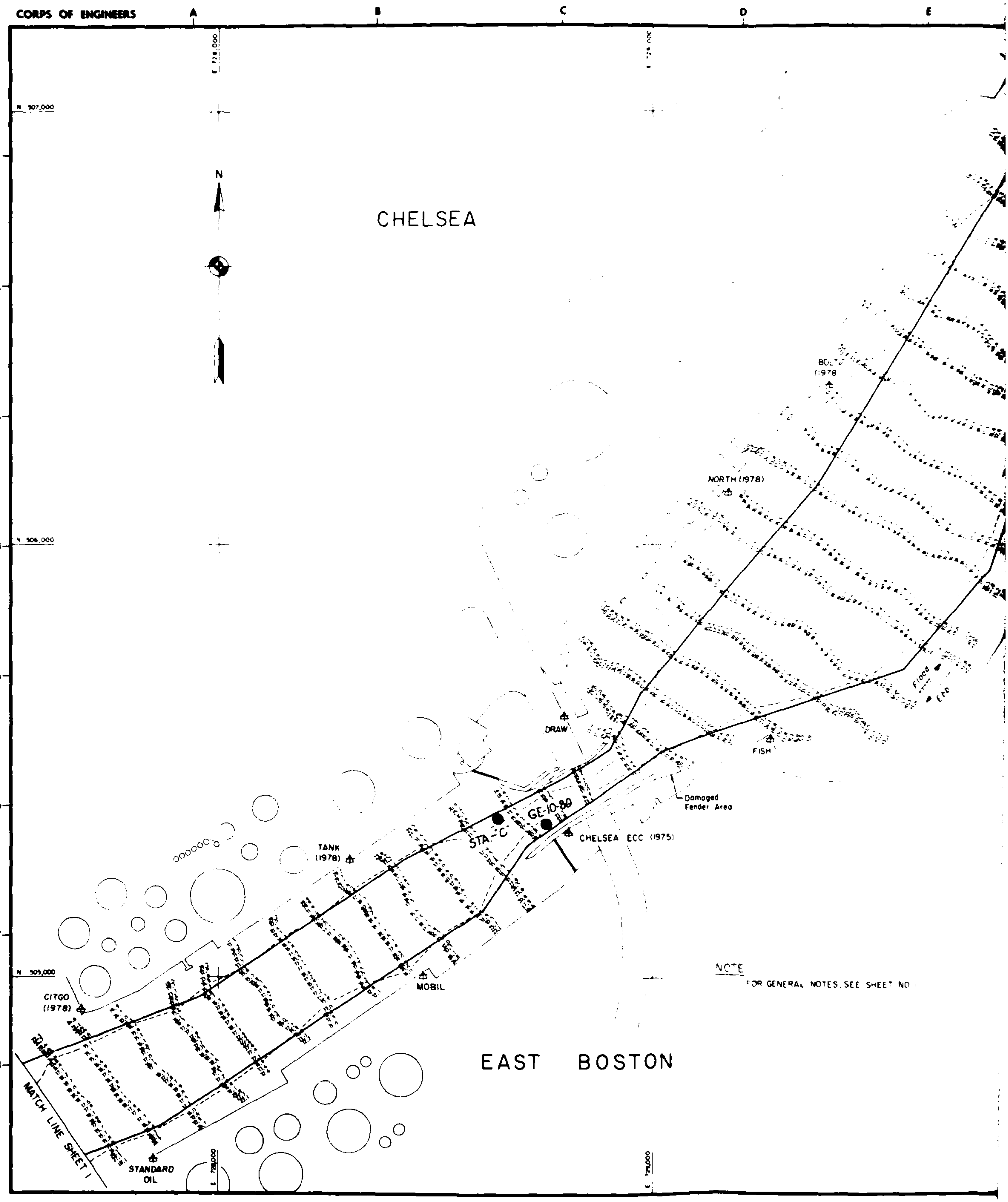
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS
CHELSEA RIVER
BOSTON HARBOR, MA.
CONDITION SURVEY
35' CHANNEL & TURNING BASIN
APPROVED
DATE APRIL 1979
SCALE 1"=100'
SPEC. NO. DACW 33
DRAWING NUMBER
241 Dr. 21

FIGURE 3



CORPS OF ENGINEERS
A
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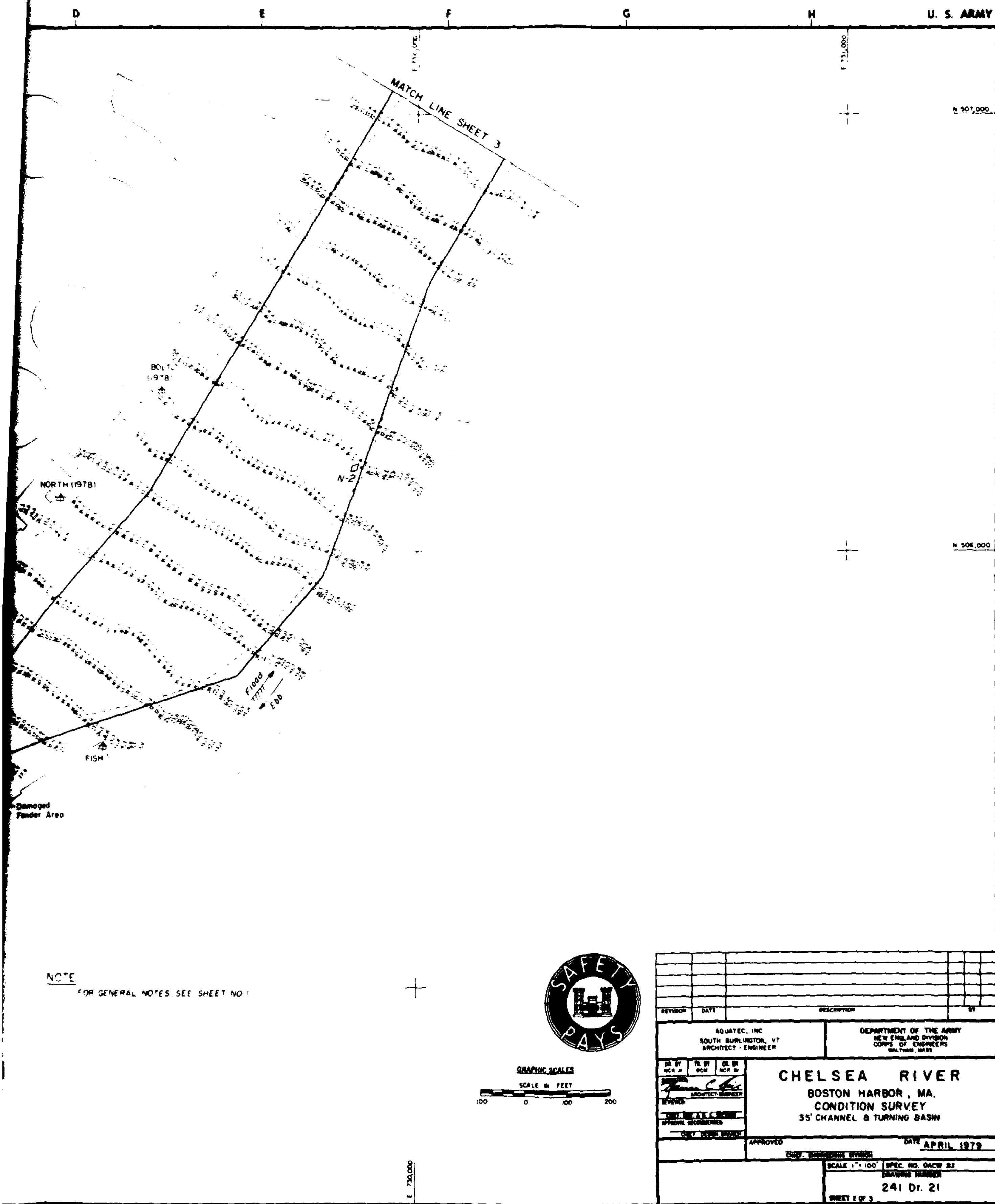
N
CHELSEA
NORTH (1978)
DRAW
FISH
Flood
Ebb
Damaged Fender Area
GE-10-80
STA - C
CHELSEA ECC (1975)
TANK (1978)
MOBIL
CITGO (1978)
STANDARD OIL
MATCH LINE SHEET 1
EAST BOSTON
NOTE
FOR GENERAL NOTES SEE SHEET NO



U. S. ARMY
D
E
F
G
H
MATCH LINE SHEET 3
N 507,000
N 506,000
E 730,000
E 731,000
BOLT (1978)
NORTH (1978)
N-2
Flood
Ebb
FISH
Damaged Fender Area
1
2
3
4
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6
7
8
NOTE
FOR GENERAL NOTES SEE SHEET NO 1
SAFETY PAYS
GRAPHIC SCALES
SCALE IN FEET
100
0
100
200
REVISION
DATE
DESCRIPTION
BY
AQUATEC, INC
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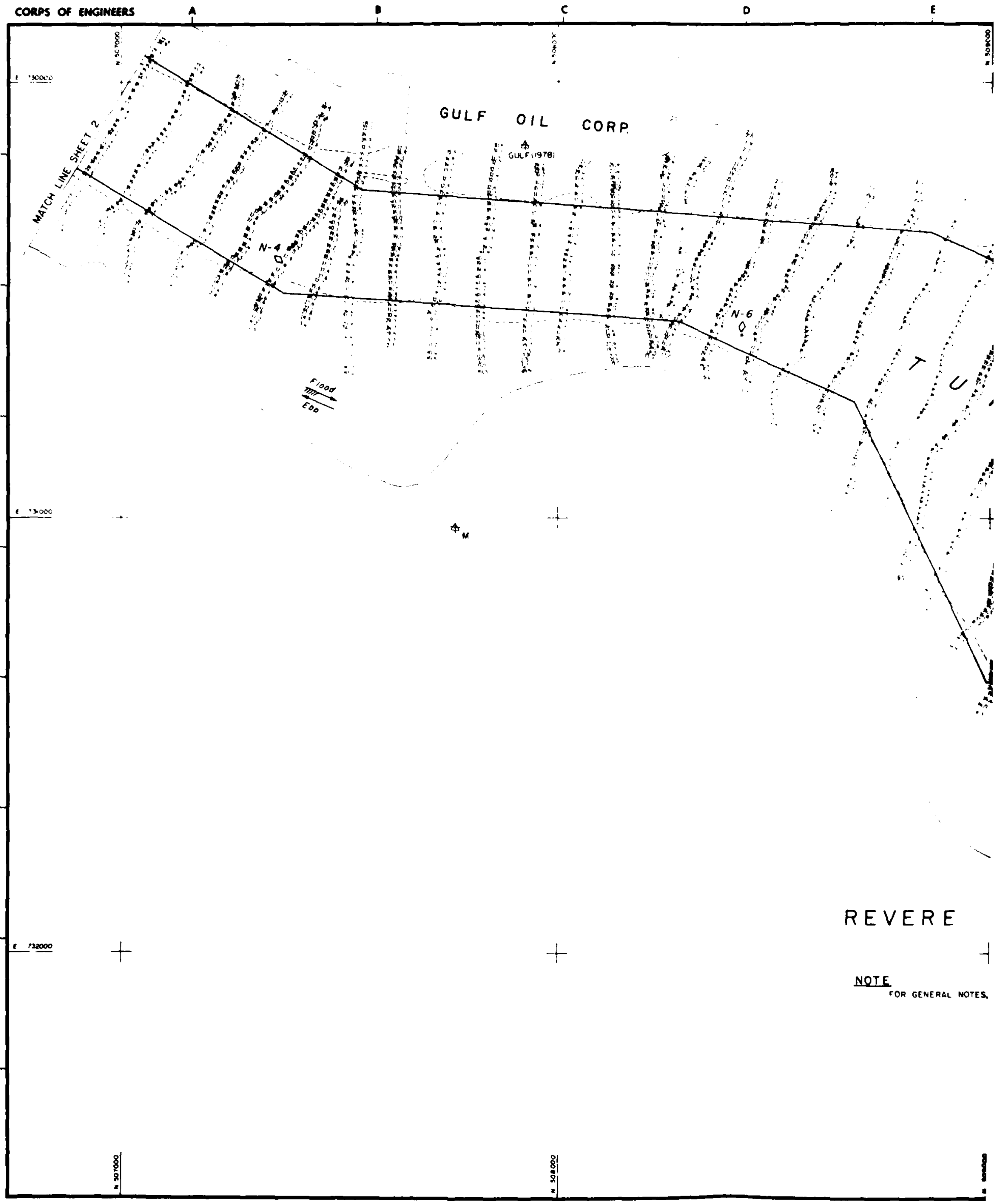
CORPS OF ENGINEERS
WALTHAM, MASS
CHELSEA RIVER
BOSTON HARBOR, MA.
CONDITION SURVEY
35' CHANNEL & TURNING BASIN
ARCHITECT-ENGINEER
APPROVED
DATE APRIL 1979
SCALE 1" = 100'
241 Dr. 21
SHEET 2 OF 3

FIGURE 4


CORPS OF ENGINEERS
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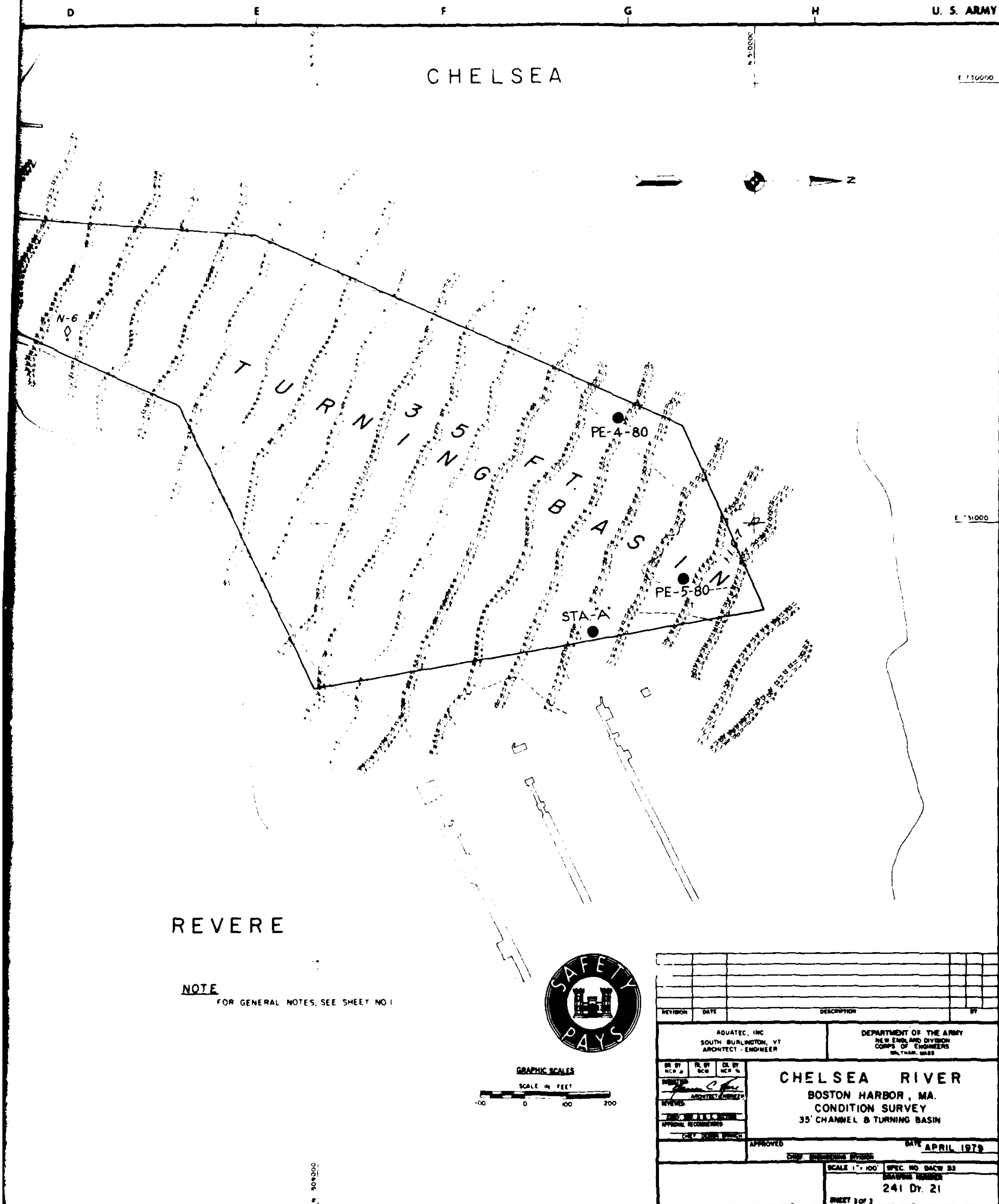
C
D
E
1
2
3
4
5
6
7
8
N 507000
N 508000
E 730000
E 731000
E 732000
MATCH LINE SHEET 2
GULF OIL CORP.
GULF (1978)
N-4
N-6
Flood
Ebb
M
T
U
REVERE
NOTE
FOR GENERAL NOTES,


U. S. ARMY
CHELSEA
TURNING BASIN
35 FT.
N-6
PE-4-80
PE-5-80
STA. A
REVERE
NOTE
FOR GENERAL NOTES, SEE SHEET NO I
GRAPHIC SCALES
SCALE IN FEET
100 0 100 200
REVISION
DATE
DESCRIPTION
BY
AQUATEC, INC
SOUTH BURLINGTON, VT
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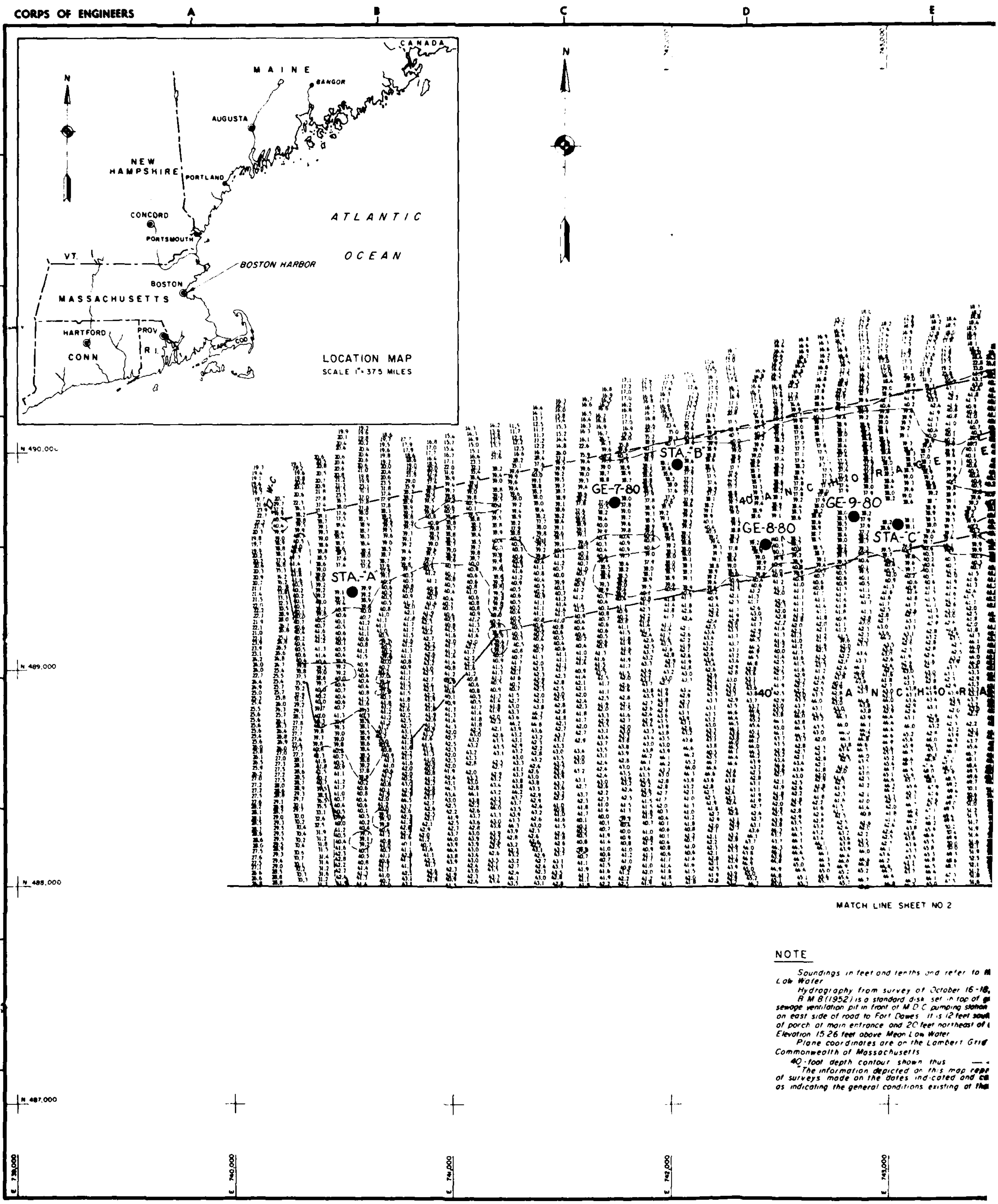
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS
CHELSEA RIVER
BOSTON HARBOR, MA.
CONDITION SURVEY
35' CHANNEL & TURNING BASIN
APPROVED
DATE APRIL 1979
SCALE 1" = 100'
SPEC. NO. DACW 33
DRAWING NUMBER
241 Dr. 21
SHEET 1 OF 3

FIGURE 5


CORPS OF ENGINEERS
A
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C
D
E
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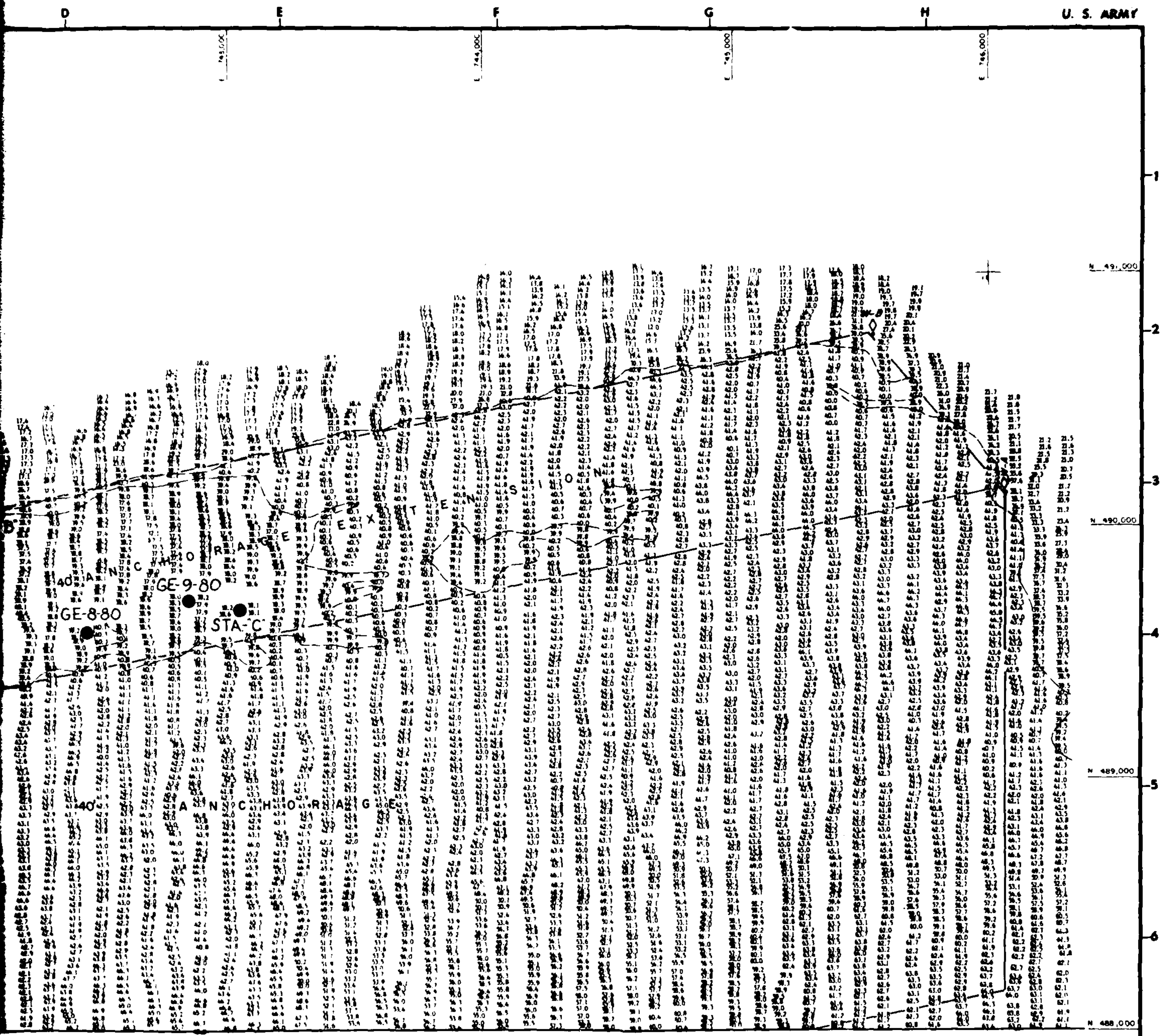
3
4
5
6
7
8
N 490,000
N 489,000
N 488,000
N 487,000
E 739,000
E 740,000
E 741,000
E 742,000
E 743,000
CANADA
MAINE
BANGOR
AUGUSTA
NEW HAMPSHIRE
PORTLAND
CONCORD
PORTSMOUTH
ATLANTIC
OCEAN
VT.
BOSTON HARBOR
BOSTON
MASSACHUSETTS
HARTFORD
PROV
CONN
R.I.
CAPE COD
LOCATION MAP
SCALE 1" = 375 MILES
N
STA.-A
STA.-B
STA.-C
GE-7-80
GE-8-80
GE-9-80
ANCHORAGE
40
MATCH LINE SHEET NO 2
NOTE
Soundings in feet and tenths and refer to M
Low Water
Hydrography from survey of October 16-18,
B M 8 (1952) is a standard disk set in top of
sewage ventilation pit in front of M D C pumping station
on east side of road to Fort Dawes it is 12 feet south
of porch at main entrance and 20 feet northeast of
Elevation 15.26 feet above Mean Low Water
Plane coordinates are on the Lambert Grid
Commonwealth of Massachusetts
40-foot depth contour shown thus
The information depicted on this map repr
of surveys made on the dates indicated and ca
as indicating the general conditions existing at the

U. S. ARMY



MATCH LINE SHEET NO 2

NOTE

Soundings in feet and tenths and refer to the plane of Mean Low Water

Hydrography from survey of October 16-18, 1978 by Aquatec, Inc

B M 8 (1952) is a standard disk, set in top of granite coping slab around sewage ventilation pit in front of M D C pumping station building on Deer Island on east side of road to Fort Dawes. It is 12 feet southeast from center line of porch at main entrance and 20 feet northeast of center line of road. Elevation 15.26 feet above Mean Low Water

Plane coordinates are on the Lambert Grid System for the Commonwealth of Massachusetts

40-foot depth contour shown thus

"The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"

SAFETY PAYS

GRAPHIC SCALES

SCALE IN FEET

200 0 200 400

1" = 375 MI

25 0 25 50 75 MI

REVISION	DATE	DESCRIPTION	BY

AQUATEC, INC
SOUTH BURLINGTON, VT
ARCHITECT - ENGINEER

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

DR BY NCR Jr | TR BY GCM | CK BY NCR Sr

SUBMITTED — ARCHITECT-ENGINEER

REVIEWED

APPROVAL RECOMMENDED

BOSTON HARBOR, MA
40 FOOT ANCHORAGE AND VICINITY CONDITION SURVEY

APPROVED — CHIEF, ENGINEERING DIVISION

DATE DEC 1978

SCALE 1" = 200' | SPEC NO DACW 33

DRAWING NUMBER 1813 Dr 1

SHEET 1 OF 3

FIGURE 6

II. PURPOSE AND NEED FOR THE PROJECT

The necessity of maintenance dredging in each project area is described below.

A. Mystic River:

Removal of shoal material would reduce economic losses due to tidal delays and lightering. Navigation losses are estimated to be in excess of $1 million annually. Navigation safety, which is critical due to the periodic arrival of liquid natural gas (LNG) tankers, would be improved. During the last maintenance in 1966, the project was not dredged to its upstream limit because of lack of use. Since that time new and increased use requires that the 1966 limit be extended upstream. In 1979, domestic vessels delivered 4.8 million tons of cargo and the total cargo exceeded 7.5 million tons. The major commodities include petroleum products, liquified gases, sugar, and iron and steel scrap.

B. Chelsea River:

Shoaling in the channel is relatively minor (approximately 25,000 cubic yards). However, the sediment has accumulated in areas critical to vessel maneuverability such as near resticted bridge openings. Improvement of navigation safety which decreases the possibility of oil spills and damage to bridges is the primary objective in maintaining authorized width and depth in the narrow Chelsea River channel.

C. President Roads Anchorage:

Shoaling along the northeast and northwest portions of the anchorage combined with the Logan Airport overflight path, severely restricts the amount of deep water (40 feet) anchorage available. The 40-foot depth is essential to accommodate the deep draft tankers which use the anchorage for bunkering and lightering before proceeding into Boston or going to ports along the Maine coast. In 1979, 500 vessels used the anchorage, with some staying for as long as 20 days. Dangerous crowding situations occur while vessels wait for access to berth because of ongoing offloading activities or other offloading delays.

President Roads, also known as Anchorage #2, is the only general purpose inner harbor area and handles 95% of all commercial tonnage. Anchorage #1 on Bird Island Flats is no longer large enough or deep enough to handle the ships that use the harbor. The airport fill and breakwater as well as shipping activities at the Bethlehem Shipyard drydocks severely limit the usefulness of that anchorage.

The only alternative deep water anchorage area is in Broad Sound. However, this area is fully exposed to easterly gales, has only fair holding gound, does not have launch service and is often subject to dense sea fog. Because of the lack of shelter, lightering and bunkering activities are unsafe in Broad Sound except in mid-summer.

III. ALTERNATIVES

Alternatives to the proposed action include no action and alternative methods of disposal.

A. No Action:

With the no action alternative, shoaling will continue. Extreme shoaling will cause decreased usage of the channel and anchorage areas, pose a safety hazard to navigation and lead to a negative impact on the project area. For example the shallow depth of the Mystic and Chelsea Rivers impedes the shipping of product by large vessels, thereby necessitating shipments by smaller vessels at higher total cost. Also, because of the unsafe and inefficient conditions of the channel, large ships will experience continued delays in their wait for tides to change. Realizing that Boston is the largest port in the New England area, certain commodities would experience price increases in proportion to the worsening in navigation.

There would also be greater frequency of vessel damages due to the higher risk of groundings. This not only increases the maintenance costs to the shippers but also the risk of spillage of petroleum or hazardous chemicals being shipped.

B. Alternative Methods of Disposal:

Alternative methods of dredged material disposal in the Boston Harbor area, associated with both maintenance and improvement dredging, were the subject of discussion at a 21 May 1981 interagency meeting between the Corps of Engineers and various Federal and State agencies. A number of methods of disposal of sediments were discussed, in conjunction with an ongoing Corps study (see page 9) of possible Federal navigation improvements in Boston Harbor. The alternatives are also applicable with the exception of bulkheading or containment, to this maintenance dredging project notwithstanding the difference in scope of the two projects (425,000 c.y. from this project vs the 4.3 million c.y. from the improvement project). Suggested potential alternatives at the meeting and subsequent correspondence included: the Boston Foul Area; Fort Point Channel, Boston Harbor Islands; Barrier Island creation; Logan Airport; Boston Marine Industrial Park; general sanitary landfill; quarry and gravel pits; and dredged material containment.

1. Foul Area Ocean Disposal Site. The Foul Area disposal site is the only EPA designated ocean disposal site in the Boston area. Disposal would be acceptable provided ocean dumping requirements are met and no other alternative site is available.

2. Fort Point Channel. In conjunction with development of the downtown Boston area, the Corps suggested disposal in the Fort Point Channel for development of the much valued harborfront property. However, there are a multitude of water-related projects planned by various local

and private interests for development of the area. Filling in the channel would be in conflict with these plans and, therefore, was eliminated from consideration.

3. Boston Harbor Island/Barrier Island Creation. Island and marsh creation and/or reclamation have been suggested as a potential disposal alternative. However, such disposal would require the use of relatively "clean" materials to minimize any chemical impacts to the water quality and aquatic organisms. The sediments derived from this project are not considered "clean" and, therefore, would not be appropriate for shallow water or intertidal disposal.

4. Logan Airport/Boston Marine Industrial Park. These projects, as currently proposed by Massachusetts Port Authority, presently have no need for fill material. The material provided by this project would also not be suitable for subsequent structural development of the filled sites. In addition, shallow water or intertidal disposal of the clam flats in the Logan Airport area would require clean fill as well as mitigation of the lost clam habitat.

5. General Sanitary Landfill Cover. The use of dredged material as a sanitary landfill cover would also be a potential disposal method. Such disposal would require use of clean material to minimize the impact of pollutants leaching from the dried dredged sediments to the surrounding environment. The drying of dredged sediments leads to the formation of acid conditions which can chemically change previously unavailable contaminants to more soluble forms (Gambrell et. al. 1978). In addition, sites such as the Lynn Landfill Site can only receive about 30,000 c.y., which is about 7% of the total dredged volume. A large number of such disposal areas would be needed to accommodate the volumes generated by this project. This would result in a multitude of logistical problems. The cost of transportation would have to be borne by local interests.

6. Quarries and Gravel Pits. A quarry in Quincy was also suggested as a potential disposal site. However, questions such as where and by whom the material would be brought ashore, who would pay for the trucking, and how the material would be stored temporarily would need to be resolved. All rehandling costs would be local responsibilities.

7. Dredged Material Containment. There are presently no available containment faciliites which could receive the dredged materials. Construction of such a facility would require suitable material such as quarry stone and rock filter to contain the sediments. Since no authorization currently exists to develop such a facility, the cost would have to be borne by local interests.

It is apparent that disposal alternatives 2 - 7 may be rejected based on a variety of engineering, logistical, economic and environmental reasons. This conclusion has been supported by the Massachusetts Department of Environmental Quality and Engineering in a 17 June 1981 letter. Thus, the only reasonable option is ocean disposal at the designated Foul Area Site.

IV. ENVIRONMENTAL SETTING

A. BOSTON HARBOR

1. General

Boston Harbor is located on the coast of Massachusetts approximately equidistant between Cape Cod and the New Hampshire border (see insert of Figure 7). The harbor is formed by a group of outlying islands and the peninsula areas of Winthrop and Hull. For the purpose of this report, the harbor can be divided into the following sections: Mystic River; Chelsea River; the Boston Inner Harbor, which includes the main ship channel, lower Charles River, Fort Point Channel and the Reserve Channel; and Boston Outer Harbor, which includes Dorchester Bay, Quincy Bay, Hingham Bay, President Roads and Nantasket Roads.

The harbor is the largest port in the New England region, covering approximately 47 square mile area. It is utilized by shipping, commercial, industrial, fishing and recreational interests.

Since 1965, approximately 2.36 million cubic yards (c.y.) of dredged material and rock have been removed from various reaches of the harbor including Mystic River, Mystic and Chelsea River confluence, Main Ship and Broad Sound channels. The Corps of Engineers is currently studying the feasibility of providing a 45-foot depth at MLW by removing 4.3 million c.y. of harbor sediment and 675,000 c.y. of ledge to improve the harbor's navigability.

2. Tidal Currents and Harbor Circulation

The principal currents in the harbor are tidal in origin, although wind driven currents occur during storms. Freshwater flows discharged from the Mystic, Charles and Chelsea Rivers generally overlie the more dense seawater flows from the tides. Freshwater flows average 500 cubic feet per second (cfs) in the summer. Tidal input are orders of magnitude greater with volumes ranging from 10.6 billion gallons at low tide to 179.9 billion gallons at high tide (Metcalf and Eddy, 1976). Approximately 73.3 billion gallons are exchanged through three channels linked with the President Roads area and one channel linked with Nantasket Roads.

The average tidal range in Boston Harbor is 9.5 feet with spring tidal ranges often in excess of 11.0 feet. Average current velocities for the Inner Harbor are less than 0.5 knots. Velocities in other portions of the harbor are generally less than 2.0 knots, with the exception of restricted passages such as between Peddocks Island and Hull where the maximum predicted velocities are in excess of 2.5 knots. Maximum current velocities during spring tide at the areas to be dredged are as follows: 0.1 knot in the Mystic River, 0.2 knot in the Chelsea River, 0.3 knot at the confluence of the Mystic and Chelsea Rivers and 0.7 knot in the President Roads area.

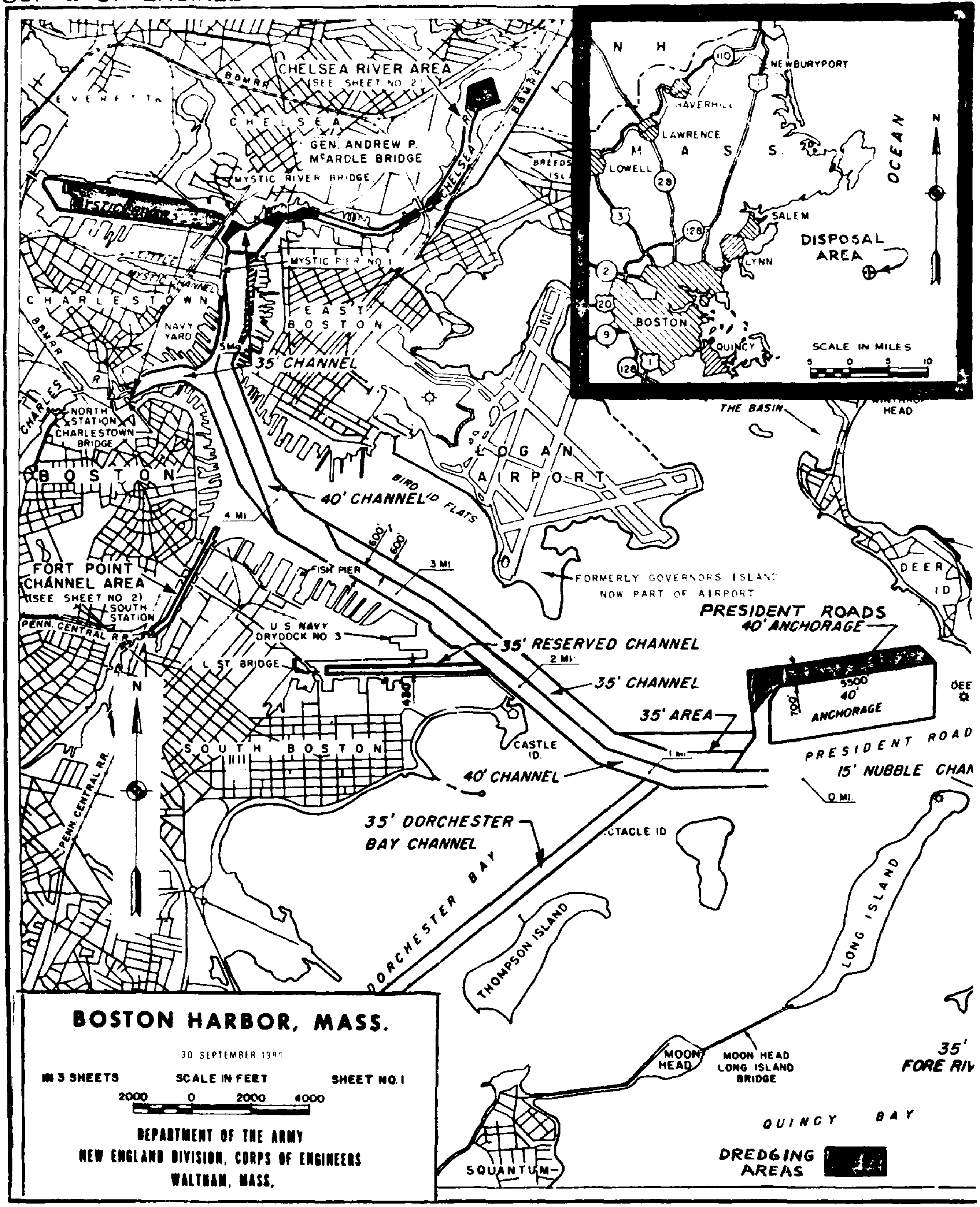

CHELSEA RIVER AREA
(SEE SHEET NO 2)
CHELSEA
GEN. ANDREW P. McARDLE BRIDGE
MYSTIC RIVER BRIDGE
MYSTIC PIER NO 1
CHARLESTOWN
NAVY YARD
EAST BOSTON
35' CHANNEL
NORTH STATION
CHARLESTOWN BRIDGE
BOSTON
40' CHANNEL
BIRD ID FLATS
LOGAN AIRPORT
FORT POINT CHANNEL AREA
(SEE SHEET NO 2)
SOUTH STATION
PENN. CENTRAL R.R.
FISH PIER
FORMERLY GOVERNORS ISLAND NOW PART OF AIRPORT
U S NAVY DRYDOCK NO 3
35' RESERVED CHANNEL
L ST. BRIDGE
35' CHANNEL
35' AREA
PRESIDENT ROADS 40' ANCHORAGE
40' ANCHORAGE
SOUTH BOSTON
CASTLE ID.
40' CHANNEL
PRESIDENT ROADS
15' NUBBLE CHAN
35' DORCHESTER BAY CHANNEL
DORCHESTER BAY
THOMPSON ISLAND
LONG ISLAND
DEER ID.
THE BASIN
WINTHROP HEAD
MOON HEAD
MOON HEAD LONG ISLAND BRIDGE
35' FORE RIV
QUINCY BAY
SQUANTUM
DREDGING AREAS
NEWBURYPORT
HAVERHILL
LAWRENCE
LOWELL
MASS.
OCEAN
SALEM
LYNN
DISPOSAL AREA
BOSTON
QUINCY
SCALE IN MILES
BOSTON HARBOR, MASS.
30 SEPTEMBER 1980
IN 3 SHEETS
SCALE IN FEET
SHEET NO. 1
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 7

3. Water Quality

The quality of water in Boston Harbor has been the target of considerable expenditures of Federal, State and private funds. Historically, the main contributors to water pollution in the harbor have been raw sewage discharges, combined sewage overflows (CSO's), partial waste treatment and sludge discharges, industrial discharges, urban runoff, oil spills, and poor quality of tributary streams. For the most part, the raw sewage and straight industrial discharges have been rectified as well as present funding and facilities will permit. The present discharge of partially treated sewage and sewage sludges and the CSO's remain the largest water quality problem in the harbor. The history of contamination is found in the harbor sediments which are discussed below.

The inner harbor and the riverine reaches that are planned to be dredged are all classified as SC waters. Such waters are classed as suitable for aesthetic enjoyment, recreational boating, industrial cooling and process use, and as habitat for indigenous wildlife and forage and game fish. The Outer Harbor areas, except for Broad Sound Channels, are classified SB waters. The classification of SB implies suitability for aesthetic enjoyment, habitat for indegenous wildlife and forage and game fish, and the harvesting of shellfish with depuration. The waters in the Broad Sound channel project areas are classified as SA. This classification implies excellent suitability for primary contact sports, excellent fish and wildlife habitiat, and possible approval for shellfish harvesting without dupuration. The assigned classifications, however, do not mean the waters meet the criteria because of the CSO's.

Water quality in Boston Harbor has been found to vary both spatially and temporally. The data contained in Table 1 are a general summary of a recent sampling program.

Barring any localized effects around thermal outfalls from power generating stations, the temperature regime in the harbor is under normal climatic and estuarine controls. The enrichment level in the Outer Harbor is generally considered to be at a mesotrophic scale without excessive primary production (National Commission on Water Quality, 1976). The Inner Harbor is also enriched from combined sewer overflows and the high level of nutrients in the river system feeding the harbor. Dissolved oxygen levels at many locations of the Inner Harbor have been impacted by the basic water quality and primary production, while in the Outer Harbor the oxygen levels have been found to be more dependent on primary production (New England Aquarium, 1973). Salinity data indicate the Outer Harbor to be well mixed, while the various regions of the Inner Harbor are very definitely under the influence of freshwater inputs. Essentially, the mouth of the harbor is considered stenohaline and the Inner and Outer Harbor areas are euryhaline. Oil pollution has created problems in many harbor areas, and a permanent oil boom is maintained at the mouth of Chelsea Creek to protect the remainder of the harbor from potential spills in the main tanker terminal area.

Table 1[1]
Water Quality Data, Boston Harbor

Parameters[2]	River Complex	Outer Harbor	Outside Harbor
Temperature °C.	0-21	0-22	0-20.5
Salinity, ppt	4-32	21-34	28-34
Chemical[2]			
D.O., ppm	2.41-11.49	6.02-14.0	6.48-12.65
Nitrogen mg/l			
Ammonia - N	0.01-1.10	0.01-1.02	0.01-0.40
Nitrate - N	.022-1.24	.001-.570	.002-.940
Organic - N			
Phosphorus mg/l			
Total	0.05-1.02	.024-1.33	.010-.133
Ortho	.007-.924	.010-1.17	.018-.082
Zinc[3] ppm	30.6-62.2	7.8-16.7	
Copper[3] ppm	2.8-6.6	1.9-8.6	
Lead[3] ppm	2.2-10.6	1.2-2.7	
Nickel[3] ppm	7.2-13.6	0.1-13.6	
Chromium[3] ppm	0.2-3.69	0.1-1.2	
Cadmium[3] ppm	0.34-0.56	0.11-1.10	
Biological[2]			
Bacterial cts. (coliform)	0-96,00	0-10,000	0-4,200

[1]Table from Jason Cortell Associates (1977)
[2]New England Aquarium (1973)
[3]New England Aquarium (1972) (values are for soluble phase)

Levels of trace metals in the Inner Harbor have been related to the sewage discharges, CSO's, urban runoff, and the metals contributed by the major rivers. Dorchester Bay has been found to contain the least amount of waterborne trace metals, with the principal source in its inner portion being the Neponset River (New England Aquarium, 1972). In the Outer Harbor, higher levels of metals have been found around the sewage outfalls. In general, the particulate phase contained greater amounts of zinc, nickel, cadmium, copper, and chromium (New England Aquarium, 1972). The New England Aquarium study did not find differences between the particulate and aqueous phases for lead. Seasonal variations were also inferred in the same study and were attributed to spring freshets. The average concentrations of trace metals in the Harbor are presented in Table 1.

The bacterial quality of the harbor waters has been extensively investigated. There are many areas in the Inner and Outer Harbors which are considered grossly contaminated; and, in spite of the water classification of a particular area, the bacterial concentrations limit the harvesting of shellfish. The general densities of total coliform bacteria are indicated in Table 1. The inputs of bacteria are principally attributable to the CSO's and those bacteria surviving treatment plant chlorination. High levels of bacteria have been found in the rivers which drain into the harbor, but the sources have never been documented. It is not unusual for the swimming beaches to be closed following a storm of moderate duration and intensity due to bacterial contamination from the CSO's.

4. Harbor Sediments

Most sediments in Boston Harbor are reworked glacial materials, with the organic fraction in the sediments generally thought to result from industrial and sewage discharges into the harbor. The most prevalent harbor sediment is a plastic clay of glacial origin, known locally as the Boston blue clay. This layer has been detected throughout the harbor in various seismic investigations (Edgerton, 1963 and 1965). The clay is often overlain by more recent sediments, including coarser silts and sands. In several areas, finer grained recent sediments ("muds") contain considerable quantities of gas, with CO_2, CH_4, and H_2S being the most prevalent.

The chemical characteristics of the harbor sediments have been studied in the last decade by the Corps of Engineers, Massachusetts Division of Water Pollution Control, the New England Aquarium and other private groups. The levels of contaminants vary throughout the harbor depending on the type of urban or industrial activities approximate to the sediments. In general, contaminant levels are relatively high in the Inner Harbor and decrease seaward. The levels, however, increase in the President Roads area near the sludge discharge outfall.

Sediment analyses were done in November 1980 by the Corps of Engineers (CE) and are presented in Tables 2, 3 and 4. Sediment samples were collected from four stations in the Mystic River (Figures 1 and 2), the Chelsea River (Figures 3, 4, and 5), and from three stations in the President Roads area (Figure 5).

A fourth station at President Roads (Station A) was supplemented with data collected in 1975.

Sediments at all stations consisted of organic fine sandy or silty clay (60-89% fines) with the exception of Station D in the Chelsea River and Station B in the President Roads area, which were organic silty fine or medium sand (20 - 47% fines).

The chemical characteristics of the sediments can be compared to those found in the Gulf of Maine tidal system. A statistical summary of the Gulf of Maine system may be found in Appendix A. The standard deviation is used to compare relative levels of contamination. A mean greater than two standard deviations (SD) from the Gulf of Maine mean indicates a relatively high level of contamination; a mean between one and two SD indicates a moderate level; and a mean less than one SD indicates a lower level of contamination.

Sediments collected at Station A in the Mystic River contained oil and grease, arsenic, vanadium, greater than two SD from the Gulf of Maine mean. The same sediments also exhibited a volatile solids, chemical oxygen demand (COD), Total Kjeldahl Nitrogen (TKN), arsenic, and cadmium levels between one and two SD. In addition, stations B and C in the Mystic River had arsenic levels between one and two SD and Station C of also had oil and grease in the same range. Station GE-8-80 and C of the President Roads contained TKN levels between one and two SD. All other levels were within one SD of the Gulf of Maine mean.

Table 2
Mystic River

Station	A (PE-6-80)		B (GE-13-80)	C (GE-1[illegible]-80)	D (GE-12-80)
Depth (ft.)	0.0-1.9	1.19-1.25	Surface	Surface	Surface
Soil Descrip.	Organic Silty Clay	Clay	Organic Fine Sandy Clay	Organic Fine Sandy Clay	Organic Fine Sandy Clay
Medium Grain Size	0.0075	0.0020	0.14	0.0160	0.0270
% Fines	95	98	84	71	61
Liquid Limit	104	48	108	84	73
Plastic Limit	42	24	39	33	29
Plastic Index	62	24	69	51	44
Specific Gravity	2.60	2.74	2.59	-	2.61
Depth	0.0-0.25	1.35-1.60	Surface	Surface	Surface
% Solids	27.28	45.15	40.37	41.99	48.59
Sediment pH	7.0	-	7.5	7.5	7.3
% Vol. Solids EPA	12.06	7.35	9.118.47	6.[illegible]2	
% Vol. Solids NED	7.78	4.88	5.80	6.28	4.50
Chemical Oxygen Demand (ppm)	212,000	-	102,000	72,100	43,400
Total Kjeldahl Nitrogen (ppm)	6,570	-	3,[illegible]70	3,510	3,230
Oil and Grease (ppm)	10,500	-	4,690	8,160	6,230
Mercury (ppm)	1.3	0.7	1.7	0.9	0.8
Lead (ppm)	137	111	119	108	77
Zinc (ppm)	224	247	198	154	122
Arsenic (ppm)	22	31	16	16	12
Cadmium (ppm)	6	12	3	3	2
Chromium (ppm)	70	66	183	158	153
Copper (ppm)	116	30	136	136	108
Nickel (ppm)	27	37	58	40	28
Silver (ppm)	220	100	250	250	215
Vanadium (ppm)	414	100	100	100	50
PCB (ppb)		200	-	-	-
DDT (ppb)		1			

Table 3
Chelsea River

Station	A (PE-4-80)		B (PE-5-80)		C (GE-10-80)	D (GE-11-80)
Depth (ft.)	0.0-1.5		0.0-1.0	1.0-1.43	Surface	Surface
Soil Descrip.	Organic Fine Silty Clay		Organic Fine Sandy Clay	Fine Sandy Clay	Organic Fine Sandy Clay	Organic Gravelly Silty Medium To Fine Sand
Medium Grain Size	0.0530		0.0610	0.0500	0.0120	0.20
% Fines	60		64	65	80	20
Liquid Limit	47		44	31	124	40
Plastic Limit	24		25	19	47	29
Plastic Index	23		19	12	77	11
Specific Gravity	2.63		2.66	2.70	2.60	2.65
Depth (ft.)	0.0-0.25	1.40-1.65	0.0-0.25	Surface	Surface	Surface
% Solids	63.04	61.66	54.33	70.78	37.85	61.11
Sediment pH	7.7	0	7.2	-	7.6	7.4
% Vol. Solids EPA	3.7	3.54	4.59	1.93	10.33	4.06
% Vol. Solids NED	2.66	2.46	3.31	1.18	7.66	2.57
Chemical Oxygen Demand (ppm)	60,6000	-	714,000	-	137,000	129,000
Total Kjeldahl Nitrogen (ppm)	2,750	-	2,190	-	4,250	1,580
Oil and Grease (ppm)	2,960	-	4,470	-	2,960	2,110
Mercury (ppm)	0.6	0.5	1.0	0.4	1.0	0.8
Lead (ppm)	45	56	70	26	103	28
Zinc (ppm)	127	167	130	90	238	72
Arsenic (ppm)	8.5	9.6	6.2	4.4	1.3	8.4
Cadmium (ppm)	2	9	3	7	1	1.5
Chromium (ppm)	275	182	175	32	219	61
Copper (ppm)	32	12	43	33	75	20
Nickel (ppm)	42	28	47	38	32	10
Silver (ppm)	118	100	150	100	195	100
Vanadium (ppm)	40	40	40	40	50	40
PCB (ppb)		560	-	-	-	-
DDT (ppb)		6	-	-	-	-

Table 4
President Roads

Station	A (PE-15-76)	B (GE-7-80)	GE-8-80	C
Depth (ft.)	0.0-1.5	Surface	Surface	Surface
Soil Descrip.	Fine Sandy Organic Silt	Surface Organic Silty Fine Sand	Organic Fine Sandy Clay	Organic Fine Sandy Clay
Medium Grain Size	0.0150	0.0730	0.0130	0.0160
% Fines	84.3	47	89	85
Liquid Limit	84	33	92	89
Plastic Limit	38	26	36	35
Plastic Index	46	7	56	54
Specific Gravity	2.59	2.63	2.60	2.57
Depth (ft.)	0.0-0.17	Surface	Surface	Surface
% Solids	39.37	68.35	38.23	48.24
Sediment pH	7.5	6.8	7.2	7.1
% Vol. Solids EPA	9.29	3.10	8.88	7.14
% Vol. Solids NED	7.93	2.12	6.50	4.96
Chemical Oxygen Demand (ppm)	124,000	30,100	114,000	80,700
Total Kjeldahl Nitrogen (ppm)	4,170	1,720	6,600	5,650
Oil and Grease (ppm)	6,800	1,350	4,730	4,320
Mercury (ppm)	1.37	0.7	1.5	1.4
Lead (ppm)	178	25	4.3	43
Zinc (ppm)	306	60	117	153
Arsenic (ppm)	7.6	3.7	7.2	8.3
Cadmium (ppm)	6.1	4	4	1
Chromium (ppm)	335	111	257	225
Copper (ppm)	200	26	64	49
Nickel (ppm)	56	9	22	20
Silver (ppm)	-	150	285	225
Vanadium (ppm)	71	40	40	40
PBC (ppb)	-	1,200	-	-
DDT (ppb)	-	1	-	-

5. Aquatic Resources:

Phytoplankton.

The phytoplankton of Boston Harbor exhibit regional, seasonal and annual changes in species and abundances related to changes in light, temperature, nutrients, water circulation and salinity.

Generally the saltwater populations are dominated by the centric diatoms *Skeletonema costata*, *Detonula confervacea*, and *Thallissiosira nordenskioldii*, whereas freshwater inflows such as in the Mystic River are dominated by the freshwater diatom *Asterionella formosa*, green algae (Chlorophyceae) or blue-green algae (Cyanophyceae). Phytoplankton densities are generally considered relatively high due to the high organic loads. The Mystic River, Chelsea River and the Inner Harbor areas have higher population levels than the Outer Harbor.

More information on the phytoplankton distribution, abundances, and species may be found in Stewart (1968) and Marine Environmental Services (1970; 1972, a, b, c; 1973; 1976, a, b; 1977, a, b).

Zooplankton

Zooplankton populations also exhibit regional, seasonal and annual differences based on the above stated physical and chemical factors as well as the phytoplankton distribution. Calanoid copepods such as *Acartia clausi*, *A. tonsi*, *Centropages hamatus*, and *Eurytemora herdmani* are dominant and exhibit seasonal changes during the year. A variety of less abundant zooplankton, planktonic eggs and larvae are also present. A complete list of species and abundances are available in MES (1970; 1972, a, b, c; 1973; 1976, a, b; 1977 a, b).

Benthos

The harbor benthic faunal assembages have been studied in the lower Mystic River and Inner Harbor areas (Stewart 1968; MES 1970; 1972, a, b, c; 1973; 1976, a, b; 1977, a, b). The communities are primarily made up of opportunistic deposit feeders such as polychaetes, amphipods, and shrimp which are associated with the harbor's organic silts. Recent studies have indicated that the lower Mystic River is dominated by the polychaete *Capitella capitata* (MES, 1977 a, b). Other species were less abundant and are exhibited in Appendix B. Abundances, biomass and diversity of the benthic fauna were highest just below Amelia Earhart Dam and decrease downstream (MES, 1976, 1977, a, b). This was the reverse of previous studies (MES, 1972, a, b; 1973). A similar reverse was exhibited by zooplankton (MES 1977 b). It appears that the benthic communities in the river area are generally unstable due to the strong urban-industrial influence which disturb and/or pollute the sediments.

The fine sediments of the Outer Harbor and presumably the President Roads area have a similar assembly of fauna as in Appendix B. However the sandy areas of the Outer Harbor probably have different benthic assemblages such as listed in Appendix C. Such communities are more associated with coarser sediments typical of high energy currents.

Fisheries

Finfish:

A number of studies on the finfisheries of the Inner and Outer Harbors have been recently accomplished. The MES (1972, 1972 a, b, c; 1973; 1976 a, b; 1977 a, b) and Haedrich and Haedrich (1974) studies have developed information in the Lower Mystic River. Data in the Outer Harbor was developed by Jerome et al (1966), Chesmore et al (1971) and Iwanowicz et al. (1973).

The studies on the Lower Mystic River were concentrated in the area between Amelia Earhart Dam and the Mystic River (Tobin) Bridge. Haedrich and Haedrich (1974) found that the seasonal species composition was similar to other northeast harbor communities. Winter flounder, smelt and alewives are found in the river throughout the year and are, therefore, considered residents. Ocean pout and blueback herring are summer residents, whereas sea herring is considered a winter resident. Other seasonal transients are indicated in Appendix D.

Haedrich and Haedrich (1974) found the major food sources are generally low diversity. Winter flounder feeds mainly on the polychaete Capatella capitata and soft shell clams; smelt primarily on sand shrimp (Crangon septemspinosa) and other small crustaceans; and alewives and herring on zooplankton.

Information on spawning species, numbers and quality of spawn and their significance to regional resources is imprecise and sketchy. Since the principal streams discharging into the Inner Harbor rivers have dams located in tidal waters and the upstream waters have been of poor quality, significant spawns of smelt and alewives are unlikely. In addition, it is not known if winter flounder use Boston's Inner Harbor for spawning as well as an area of local feeding. From the habits of these fish and from their behavoir in the Mystic River channel area, they appear to stay in particular resident areas within the Inner and Outer Harbors. Larval contribution to the eventual recruitment of these fish in other areas is not known.

Offshore and longshore areas of the harbor were trawled for finfish in the studies done by the Massachusetts Division of Marine Fisheries. Atlantic silverside, mummichog and Atlantic tomcod were the predomininant species found in the longshore trawls. Some of the offshore sampling sites yielded high densities of winter flounder, Atlantic tomcod, four-spine stickleback, and rainbow smelt. The highest densities of finfish

were taken during the months of September and October, with Atlantic silverside and winter flounder the predominant species. The densities of finfish dropped during the winter months of December through March as the fish moved offshore to winter feeding grounds.

Shellfisheries:

The softshelled clam (Mya arenaria) is the most important commerical shellfish within the Boston Harbor area. Blue mussels Mytilus edulis) and duck clams (Macoma baltica) are also found in shellfish beds but are not harvested. Densitites of shellfish beds have been documented by the Jerome et al. (1966), Chesmore et al. (1971) and Iwanowicz et al. (1973) and this data should be referred to for detailed information.

Waters overlying the shellfish beds are contaminated by wastes from sewage outfalls, resulting in the presence of coliform bacteria in the shellfish. The beds are under the jurisdiction of Massachusetts DEQE and are closed to commerical and noncommercial harvesting, except by Master Diggers who must have the clams depurated at the Newburyport Shellfish Purification Plant.

Most of the productive softshelled clam beds near the proposed project are closed except for restricted areas near Logan Airport and a seasonal area in Pleasure Bay, the latter located immediately southwest southwest of Castle Island, Logan Airport are one nautical mile north of President Roads and the beds in Pleasure Bay are about two nautical miles west of President Roads. Shellfish beds open to Master Diggers are created within the lower bays and are substantially distant from the shipping channels.

The limited amount of lobstering within the Boston area takes place primarily in Quincy, Dorchester and Hingham Bays. Lobstering is minimal or nonexistent in the areas to be primarily affected by the proposed work with the exception of the President Roads area where activities will be coordinated with the fishery.

B. The Foul Area Ocean Disposal Site (Boston Foul Area)

1. General

At the present time, the closest EPA designated ocean disposal site (Environmental Protection Agency (EPA), 1977) for contaminated waste is the "Boston Foul Area" (see Figure 8). The Foul Area is approximately two miles in diameter and is located 22 nautical miles east of Boston with its center at latitude 42°25'N, longitude 70°35'W. The site has a history of being used for the disposal of dredged materials and industrial wastes. Physiographically, the site lies within the Stellwagen Basin, an elongate depession over 20 miles in length which trends northwest-southeast (Figure 8). The dump site is situated in a 300 foot-depression which is separated from the Stellwagen Bank area on the east by a 200-foot high slope.

Schlee et al. (1974) have characterized the bottom sediments of much of the area as clayey silts. Holocene sediments thicknesses in the Foul Area average in excess of 130 feet.

Bottom currents in the basin and at the Foul Area specifically have been investigated by Butman (1973), Bumpus (1974), Halpern (1971), and the New England Aquarium (NEA, 1975). Maximum velocities on the bottom at the Foul Area (measured one meter off the bottom) have been reported at 0.8-1.0 feet per second (26-29 cm/sec). Current monitoring during 1974 was carried out by the New England Aquarium (1975). Mean bottom currents reported were between 0.13 and 0.16 feet per second (4-5 cm/sec) with maximum bottom currents averaging 0.5 feet per second (16 cm/sec). Work by Butman (New England Aquarium, 1975) has shown that during winter storms bottom currents (opposite in direction to wind direction) were of sufficient magnitude to potentially move suspended solids 12.5 miles (20 km). Bumpus (1974) indicates that net drift in this area is shoreward. The NEA has summarized seaward current trends, based on 1974 current meter data as follows:

Winter Towards SE	Summer - W
Spring Towards S or W	Fall -N

These are average directions, however, and storm activity can modify these on a seasonal basis.

2. Water Quality

The water quality of the Foul Area has been evaluated by the New England Aquarium (1975). The data gathered indicate that the temperature regime is seasonally dependent, with a thermocline developing during late April and May and weakening during the late fall. At that time a 13.5°C temperature difference was noted in the water column. Data for salinity showed little change during the fall and winter, but a decline during the spring was noted presumably due to fresh water unputs from the Merrimack River. The background salinity for the area is 32.2 ppt. Dissolved oxygen levels were found to be influenced by the various periods of primary production and plankton die-off. The lowest concentration was noted to be 6.82 mg/l at the surface during April. The fall decline throughout the water column is attributed to increased levels of respiration while the influence of the spring and summer blooms are clearly evident. During the summer, oxygen levels have been noted to be above saturation at some locations. The nutrient relationships also reflect the influence of phytoplankton growth and die-off, particulary as the level of phosphorus declines sharply and the nutrient becomes limiting in the trophogenic zone. There are rising concentrations of nutrient material during the summer below the thermocline, and increased concentrations of ammonia have been found at the bottom of the water columns during disposal of dredged material. Average annual nurtient levels are indicated in Table 5.

The average annual metal levels for the Foul Area waters are also exhibited in Table 5 (New England Aquarium, 1975). With the exception of periods during which dredged material was being dumped, trace metal levels were within acceptable levels. Lead did, however, reflect some seasonality, and significant differences in the concentrations of other metals were detected between stations and at certain depths.

3. Sediments

Sediments in the Foul Area are primarily composed of fine grained silts and clays with some sand and gravel in the northeast portion of the area. Acoustic profiling of the areas in Stellwagen Basin, where the Foul Area is located, indicates that thick deposits of recent sediments are accumulating in the basin. It is thought that the basin is a natural sediment sink for fine grained terrigenous sediments from the Massachusetts coast, perhaps from as far away as the Merrimack River.

The chemical properties of the Foul Area sediments also were documented by the New England Aquarium (1975). Reasonable consistencies were found in the concentrations of some metals between the sample locations. There were others, however, that varied by several orders of magnitude. The average chemical characteristics of the Foul Area sediments are presented in Table 6. By comparison with Boston Harbor it can be seen that the sediments have a relatively moderate to high level of volatile solids but a low level of oil and grease.

There are also low concentrations of mercury, lead, zinc, chromium, copper and vanadium. The concentrations of nickel, cadmium, and arsenic are moderate to high in relation to the Boston Harbor project areas. In comparison to other marine environs, such as Buzzards Bay (Table 6), the trace metal levels at the Foul Area are elevated over what could be considered background concentrations commensurate with the hydrogeological regimes of the area.

TABLE 5
Water Quality of Boston Foul Area 1973-1974*

	Minimum	Annual Mean	Maximum
Nitrate N (ppm)	<.001	0.003	0.010
Nitrate N (ppm)	<.0001	0.105	0.260
Ammonium N (ppm)	<.022	0.045	0.112
Ortho Phosphate (ppm)	<.001	0.025	0.050
Lead (ppm)	<.1	2.3	1.4
Zinc (ppm)	2	21	69
Cadmium (ppm)	<.05	0.3	1.0
Chromium (ppm)	<.1	0.4	1.1
Copper (ppm)	.3	2.3	7.0
Nickel (ppm)	.2	1.8	6.5

*Data from New England Aquarium (1975)

Table 6
Comparison of the Sediment Quality of Boston Foul Area
With Boston Harbor and Buzzards Bay Sediments

Location	Composite of Boston Harbor Sediments (1)	Composite of Boston Foul (2)	Buzzards Bay (3)
Soil Descrip.	Silty Clay	Silty Clay	-
% Vol. Solids EPA	7.39	7.62	4.2
Oil and Grease (ppm)	5,913	940	135
Mercury (ppm)	1.0	0.59	0.21
Lead (ppm)	88	60.94	22.8
Zinc (ppm)	165	140.44	75.1
Arsenic (ppm)	14.2	13.25	2.8
Cadmium (ppm)	4.3	3.43	1.6
Chromium (ppm)	138	73.75	29.1
Copper (ppm)	89.7	21.13	10.9
Nickel (ppm)	30.8	37.56	20.0
Silver (ppm)	189.4	-	-
Vanadium (ppm)	114	53.69	47.5
PCB (ppm)	420	52.13	193.00

(1) Corps of Engineers, 1980 data
(2) New England Aquarium (1975)
(3) Summerhayes (1977)

4. Aquatic Resources

Benthos

Biological data on the Foul Area were collected by the New England Aquarium (1976) as part of a study of polluted materials in Massachusetts Bay. Most of the bottom sediments in the foul area are of clayey silt composition, so that organisms which typically inhabit this substrate were detected in the sampling. Polychaete worms dominated two replicate samples with Prionospio malmegereni, Spio filicornis, and Heteromastus filiformis being the most abundant. A bivalve (Thayasira) occurred in 75% of the samples.

In addition to these benthic organisms, shrimp, flounder, and starfish were found at the site.

The faunal assemblages at the Foul Area were studied by the New England Aquarium (1975). The Foul Area showed low abundances and high diversities of marine invetebrates. Most of the stations within the Foul Area were reflective of sightly altered conditions due to a history of dredged material disposal. The most dominant organisms were the polychaete worms, Spio filicornis and Heteromastus filiformus. The dominant organisms of the Foul Area were similar to organisms found in areas with similar sediment composition in other sections of Massachusetts Bay (New England Aquarium, 1976). However, the total numbers of individuals at the Foul Area were low compared to other areas. As an example, 52-123 individuals were obtained with a $0.1m^2$ grab at the stations within the Foul Area, while 178 to 1,365 at stations outside of the Foul Area were obtained. Although the Foul Area has a high diversity of organisms, the low abundances leads one to believe the area does not add a large amount to the overall productivity of Massachusetts Bay.

Fisheries

Stellwagen Basin contains food and spawning habitat for a variety of marine fisheries which are utilized by commercial and recreational interests. Data from trawls in the area indicate that the dominant species are Atlantic cod (Gadus morhua), haddock (Melanogrammus aegiefinus), white flounder (Pseudopleuronectes americanus) and little skate (Raja erimacea) (National Marine Fisheries Service, personal communication). Other important species include yellowtail flounder (Limandos ferruginea), silver hake (Merluccius bilinearis), American plaice (Hippoglossoides platessoides), and pollack (Pollachius vivens). Most fishermen avoid the immediate Foul Area because of the debris and pollution from previous disposal operations.

Endangered Species

Data from an annual report prepared for the Bureau of Land Management indicates that Stellwagen Bank (east of the Foul Area) is currently used

by two species of turtles and three species of whales (URI, 1981). The leatherback turtle (Dermochelys coriacea) and the loggerhead turtle (Caretta caretta) are designated by the National Marine Fisheries Service (NMFS) as endangered and threatened, respectively. All three species of whales, the humpback, (Megaptera novaengliae), the finback whale (Baleanoptera physalus), and the right whale (Eubalaena glacialis) are all designated as endangered. NMFS has indicated that the Stellwagen Bank is extensively used as a feeding ground by the humpback and finback whales from May through October. On the other hand, sitings of the leatherback and loggerhead turtles and the right whale are rare in the area.

Siting information in the affected area has been documented by the University of Rhode Island (URI, 1981). Review of the data indicates that within a 75 square nautical mile area surrounding the Boston Foul Area (70° 30' - 40'W and 42° 20' - 30'N), only two sitings of whales were made during the year 1979 (Figure 8). The sites were 2.4 and 3.7 nautical miles northeast and east of the disposal site buoy, respectively. Both were verified as finback whales. No humpback or right whales were sighted in the 75 square mile area. Sitings were more common along the Stellwagen Bank area, east of the dump site, where the major food species, the sand lance (Ammodytes americanus) has suitable habitat (clean sand and fine gravel). This area is separated from the dump site by the previously mentioned slope.

V. ENVIRONMENTAL CONSEQUENCES

A. Impacts of Dredging

1. The Action of Dredging

Dredging of the Mystic and Chelsea Rivers and the President Roads Anchorage area will be accomplished by a clamshell dredge. The sediments are excavated from the bottom by a jaw shaped apparatus called a clamshell, which is operated by a crane mounted on a barge, and then deposited into the scow for transport to the disposal site. Each load is picked up as one cohesive mass and thus allows for minimal dispersion of the sediments into the water column. The resulting alteration of the aquatic environment and its impacts on the aquatic resources are discussed below.

2. Alteration of the Environment

a. Water Quality

The act of dredging suspends and exposes the dredged sediments and its constituents to the water column (see above). The result is a temporary increase in turbidity and oxidation and solution of sediment contaminants.

i. Turbidity

Turbidity levels during clamshell dredging increase primarily as a result of the dredge disturbing the bottom sediments and through bucket loss. Because of the differences in sediment characteristics, ambient currents and skill differences among dredge operators, it is difficult to determine precisely the amount of turbidity that will be generated by dredging.

Studies by Bohlen *et al.* (1979) were done during the dredging of the Thames River estuary in New London, Connecticut, partly to estimate the magnitude and character of clamshell dredge-induced sediment resuspension. Approximately 1.5 to 3% of the sediment volume of each bucketload was introduced into the water column, producing suspended material concentration adjacent to the dredge of 200 - 400 mg/l. These levels exceeded background levels by two orders of magnitude and were nearly an order of magnitude less than storm-wave-induced suspension. The sediments of the Thames River estuary were similar to those of Boston Harbor.

Once in suspension, the sediments settle out according to particle sizes. Physical properties of the sediment and seawater may be used to predict the time it takes for the suspended solids to settle out. Jason Cortell Associates (1977) compared the settling times for various reaches of Boston Harbor dredged sediments for the Corps of Engineers (Table 7). The settling times in Table 7 indicate that 75% of the sediment (by weight) will have settled between 1/2 to 21 days after dredging. The

majority of this fraction (50% of 75%) would have settled in 1.5 hours to 93 hours. The very fine sediment fractions would take longer.

Table 7
Settling Times and Net Movement of
Sediments Dredged in Boston Harbor

Location	Settling Time (hrs) 50% of Sediments	75% of Sediments	One Spring Tidal Cycle (yards)
Mystic River	93	495	298 (Ebb Tide)
Chelsea River	1.5	13.3	1,500 (Ebb Tide)
President Roads	5.8	[illegible]22	1,650 (Flood Tide)

Once suspended in the water column the sediment particles may move according to the current present at the time of dredging. The distances of net movement during spring tides at the dredge site have been calculated by Jason Cortell Associates (1977) (Table 7). Movement would not be more than approximately 300 yards for the Mystic River, 1,500 yards for the Chelsea River and 1,650 yards for the President Roads area. In most cases, turbidity levels at these distances may be within the range of natural variations in turbidity.

ii. Release of Contaminants

The immediate problem facing dredging and dredged material disposal is the question of increased availability of metals and other constituents that may have a deleterious impact on water quality and on the marine biota. Estuarine sediments, which are usually fine-grained and highly organic, serve as a sink for a variety of heavy metals and other pollutants, resulting in their accumulation. Any release of heavy metals and other pollutants from sediments upon dredging is an extremely complex process that is affected by numerous environmental variables including pH, dissolved oxygen, chemical characteristics of the intertidal waters, physical and chemical states of the pollutants and sediment gain size.

Since bucket dredges normally operate quite efficiently, i.e., only a small fraction of the dredge material escapes into the water column, there would be little opportunity for significant contamination of the harbor waters. In fact, heavy metal concentrations may even decrease, in some cases, due to absorption onto suspended silt and clay particles.

The general consensus of people investigating metal release during resuspension of bottom materials indicates that there is no blanket or extensive release of metals from dredged materials. Even though metals are found in the sediments, their total concentrations do not determine the transfer of metals across the sediment-water interface. Bulk chemical analysis alone is not adequate to determine potential releases and impacts of a metal (Lee _et al_, 1976; Hirsh, DiSalvo and Peddicord, 1978).

Studies on metal transport under dredging conditions report that there is no substantial release of metals. Their mobility is restricted since they are not readily soluble and would be adsorbed to sediments, coprecipitated out of solution or incorporated with iron oxides or sulfide bearing sediments (Lee and Plumb, 1974; Chen et al., 1976; Burks and Engler, 1978).

The primary chemical effect at the dredge sites would be associated largely with exposing anaerobic bottom sediments. Their exposure would cause the reduced chemical compounds to exert an immediate oxygen demand on the overlying waters. Coupled with the oxygen already being consumed for biological respiration and the decomposition of organic material, dissolved oxygen levels would be depleted in the primary impact areas. Low oxygen levels in combination with other dredging effects may be sufficient to produce enough stress in portion so the aquatic community to result in sporadic fish kills. However, since the disturbance would be limited to small bottom areas at any one time, tidal flows bringing well-oxygenated waters into the harbor would tend to reduce the duration and severity of these effects. In addition to oxygen depletion, dredging anaerobic sediments may liberate hydrogen sulfide gas, temporarily causing some unpleasant odors.

Potential release of sediment contaminants into the water column may be evaluated by use of the standard elutriate test as outlined in the Ecological Evaluation of Proposed Discharge of Dredged Materials into Ocean Waters (Environmental Protection Agency (EPA)/Corps of Engineers (CE), 1977). Here, the sediment is mixed with four parts seawater and shaken for 30 minutes. After settling for one hour the filtered elutriate is analyzed for sediment contaminants. Levels of contaminants are compared with levels in a water sample taken from the dredged or disposal site. (The one-to-four sediment-water ratio was designed to simulate worst case mixing which would occur during hydraulic dredging. Since the clamshell dredge will be used in this case, mixing would not occur to the degree exhibited by the elutriate tests. The sediment generally remains together as a more cohesive mass which reduces exposure to the water column.)

Elutriate tests were performed on sediment taken from the Mystic and Chelsea Rivers and the President Roads area of Boston Harbor. The results are shown in Tables 8, 9 and 10. Three replicate tests (R1, R2, and R3) were done on each sediment sample The locations of the samples are shown in Figures 1 - 6.

The data in Tables 8, 9 and 10 indicate potential releases of ammonia nitrogen, oil and grease, lead, zinc, nickel and polychlorinated biphenyls (PCB's) from the Mystic River sediments; ammonia nitrogen, lead, zinc, copper nickel and PCB's from the Chelsea River station; and ammonia nitrogen, phosphorous, oil and grease, mercury, zinc, arsenic and PCB's from the President Roads area.

Release of nutrients, such as nitrogen and phosphorous would be localized and temporary and may lead to increased biological oxygen demand. This would not lead to further eutrophication of the Harbor areas. Comparison of the values in Tables 8, 9 and 10 with recent EPA criteria for saltwater (EPA 1980), indicate that releases of mercury, lead, zinc, arsenic, copper, and nickel were all within acceptable limits. In contrast, PCB concentrations were above the water quality guidelines of 0.03 ppb average for a 24-hour period (EPA, 1980); no guidelines have been established for an instantaneous release although toxicity occurs above 10 ppb. However, the concentrations exhibited in Tables 8, 9 and 10 would not likely to occur during clamshell dredging. In addition, the large volumes of flowing water at the dredge site are likely to continually dilute these concentrations below toxic levels, if not the 24-hour average.

Monitoring of PCB concentrations during disposal operations in Puget Sound indicated that concentrations returned to backround levels shortly after disposal operations ceased (Wright, 1978).

Table 8

Elutriate Testing
Mystic River, MA - April 1981

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at various sampling locations with four parts water from each sampling location and (2) the virgin water from each sampling location as as follows:

Test Property	Designation and Dredge Site Water Location A EW-6-81	Standard Elutriate Sediment Depth Used in Preparation Location A PE-6-81/0.0-1/4 ft. R1*	R2	R3	Designation and Dredge Site Water Location D EW-12-81	Standard Elutriate Sediment Depth** Used in Preparation Location D GE-12-81 R1	R2	R3
Nitrite nitrogen (N), ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate nitrogen (N), ppm	0.13	0.01	0.06	0.13	0.11	0.03	0.03	0.03
Ammonia nitrogen (N), ppm	<0.5	10	2	5	<0.5	0.7	1.1	0.7
Sulfate (SO_4), ppm	3,240	2,550	2,430	2,480	3,340	2,850	2,870	2,900
Oil and Grease, ppm	<0.5	0.9	1	1	<0.5	<0.5	<0.5	<0.5
Phosphorus (P)								
ortho, ppm	0.6	<0.1	<0.1	<0.1	0.05	0.01	<0.01	<0.01
total, ppm	0.05	<0.1	<0.1	<0.1	0.05	0.01	<0.01	<0.01
Mercury (Hg), ppb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead (Pb), ppb	14	15	17	15	7	15	10	10
Zinc (Zn), ppb	100	20	50	100	1	20	20	50
Arsenic (AS), ppb	<1	<1	<1	<1	<1	<1	<1	<1
Cadmium (Cd), ppb	25	3	<0.5	<0.5	9	<0.5	<0.5	10
Chromium (Cr), ppb	<4	<4	<4	<4	<4	6	<4	<4
Copper (Cu), ppb	6	<2	<2	<2	2	2	2	2
Nickel (Ni), ppb	30	20	20	20	10	30	30	10
Silver (Ag), ppb	<80	<80	<80	<80	80	80	80	80
Vanadium (V), ppb	<40	<40	<40	<40	60	<40	<40	<40
Total PCB, ppb	0.015	13.2	13.2	9.2	<0.001	0.91	0.97	0.76
Total DDT, ppb	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001

Table 8 (Continued)

Elutriate Testing
Mystic River, MA - April 1981

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at various sampling locations with four parts water from each sampling location and (2) the virgin water from each sampling location as as follows:

Test Property	Dredge Site Water Location B EW-13-81	Standard Elutriate Designation and Sediment Depth** Used in Preparation Location B GE-13-8 R1	R2	R3
Nitrite nitrogen (N), ppm	<0.005	<0.005	<0.005	<0.005
Nitrate nitrogen (N), ppm	0.12	0.03	2.10	1.06
Ammonia nitrogen (N), ppm	0.5	1.1	1.3	1.5
Sulfate (SO_4), ppm	3,500	2,850	2,830	2,760
Oil and Grease, ppm	0.6	<0.5	<0.5	0.6
Phosphorus (P)				
ortho, ppm	0.05	0.01	0.02	0.02
total, ppm	0.05	0.01	0.02	0.02
Mercury (Hg), ppb	0.9	<0.5	<0.5	<0.5
Lead (Pb), ppb	4	7	4	14
Zinc (Zn), ppb	40	80	15	25
Arsenic (AS), ppb	<1	<1	<1	<1
Cadmium (Cd), ppb	16	20	<0.5	<0.5
Chromium (Cr), ppb	<4	<4	<4	<4
Copper (Cu), ppb	6	<2	<2	<2
Nickel (Ni), ppb	20	20	30	30
Silver (Ag), ppb	<80	<80	<80	<80
Vanadium (V), ppb	<40	<40	<40	<40
Total PCB, ppb	-	-	-	-
Total DDT, ppb	-	-	-	-

*R_1, R_2 and R_3 - Replicate determinations
**Surface grab sample only

Table 9

Elutriate Testing
Chelsea River, MA - April 1981

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at various sampling locations with four parts water from each sampling location and (2) the virgin water from each sampling location as as follows:

Test Property	Dredge Site Water Location A EW-4-81	Standard Elutriate Designation and Sediment Depth Used in Preparation Location A PE-4-81; 0.0-1/4 ft.			Dredge Site Water Location C EW-10-81	Standard Elutriate Designation and Sediment Depth* Used in Preparation Location C GE-10-81		
		R1**	R2	R3		R1	R2	R3
Nitrite nitrogen (N), ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite nitrogen (N), ppm	0.17	0.10	0.10	0.09	0.09	<0.01	0.01	0.04
Ammonia nitrogen (N), ppm	1.2	20	6	4	<0.5	6.6	2.4	12.7
Sulfate (SO_4), ppm	3,230	2,540	2,520	2,590	3,260	2,300	2,290	2,550
Oil and Grease, ppm	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5
Phosphorus (P)								
ortho, ppm	0.06		0.01	0.01	0.06	0.01	0.03	0.02
total, ppm	0.06	0.02	0.01	0.01	0.06	0.02	0.03	0.03
Mercury (Hg), ppb	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Lead (Pb), ppb	14	15	12	17	14	17	13	15
Zinc (Zn), ppb	100	40	65	65	2	15	35	35
Arsenic (AS), ppb	<1	3.3	<1	<1	<1		5.3	<1
Cadmium (Cd), ppb	13	<0.5	<0.5	<0.5	9 to 24	<0.5	<0.5	<0.5
Chromium (Cr), ppb	<4	<4	<4	<4	<4	<4	<4	<4
Copper (Cu), ppb	5	<2	<2	<2	<2	<2	5	6
Nickel (Ni), ppb	30	<5	<5	<5	10	10	20	20
Vanadium (V), ppb	<80	<80	<80	<80	<80	<80	120	90
Total PCB, ppb	<0.001	0.56	0.42	0.52				
Total DDT, ppb	<0.001	<0.001	<0.001	<0.001				

Table 9 (Continued)

Elutriate Testing
Chelsea River, MA - April 1981

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at various sampling locations with four parts water from each sampling location and (2) the virgin water from each sampling location as as follows:

Test Property	Dredge Site Water Location D EW-11-81	Standard Elutriate Designation and Sediment Depth** Used in Preparation Location D GE-11-81 R1	R2	R3
Nitrite nitrogen (N), ppm	<0.005	<0.005	<0.005	<0.005
Nitrate nitrogen (N), ppm	0.12	0.03	0.03	0.01
Ammonia nitrogen (N), ppm	0.5	0.8	1.4	0.9
Sulfate (SO_4), ppm	3,360	2,630	2,610	2,640
Oil and Grease, ppm	0.6	<0.5	<0.5	<0.5
Phosphorus (P)				
ortho, ppm	0.06	0.01	0.02	0.01
total, ppm	0.06	0.01	0.02	0.01
Mercury (Hg), ppb	<0.5	<0.5	<0.5	0.1
Lead (Pb), ppb	10		15	15
Zinc (Zn), ppb	1	10	25	45
Arsenic (AS), ppb	<1	<1	<1	<1
Cadmium (Cd), ppb	9	10	4	<0.5
Chromium (Cr), ppb	<4	<4	<4	6
Copper (Cu), ppb	11	2	3	3
Nickel (Ni), ppb	10	20	10	30
Silver (Ag), ppb	<80	<80	110	<80
Vanadium (V), ppb	<40	<40	<40	<40
Total PCB, ppb	0.001	0.10	0.05	0.09
Total DDT, ppb	<0.001	<0.001	<0.001	<0.001

*R_1, R_2 and R_3 - Replicate determinations
**Surface grab sample only

Table 10

Elutriate Testing
President Roads, Boston Harbor, MA - April 1981

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at various sampling locations with four parts water from each sampling location and (2) the virgin water from each sampling location as as follows:

Test Property	Dredge Site Water Location B EW-7-81	Standard Elutriate Designation and Sediment Depth* Used in Preparation Location B GE-7-81			Dredge Site Water Location EW-8-81	Standard Elutriate Designation and Sediment Depth* Used in Preparation Location GE-8-81		
		R1**	R2	R3		R1	R2	R3
Nitrite nitrogen (N), ppm	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite nitrogen (N), ppm	0.07	0.03	0.02	0.01	0.05	<0.03	0.03	0.03
Ammonia nitrogen (N), ppm	<0.5	2	2	3	<0.5	6	5	4
Sulfate (SO_4), ppm	3,470	2,960	2,620	2,640	3,480	2,550	2,520	2,570
Oil and Grease, ppm	<0.5	1	0.9	<0.5	<0.5	<0.5	1	1
Phosphorus (P)								
ortho, ppm	0.03		0.01	0.01	0.06	0.01	0.03	0.02
total, ppm	0.03	0.02	0.01	0.01	0.06	0.02	0.03	0.03
Mercury (Hg), ppb	<0.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Lead (Pb), ppb	17	15	12	17	14	17	13	15
Zinc (Zn), ppb	45	40	65	65	2	15	35	35
Arsenic (AS), ppb	<1	3.3	<1	<1	<1		5.3	<1
Cadmium (Cd), ppb	12	<0.5	<0.5	<0.5	9 to 24	<0.5	<0.5	<0.5
Chromium (Cr), ppb	<4	<4	<4	<4	<4	<4	<4	<4
Copper (Cu), ppb	9	<2	<2	<2	<2	<2	5	6
Nickel (Ni), ppb	20	<5	<5	<5	10	10	20	20
Silver (Ag), ppb	<80	<80	<80	<80	<80	<80	120	90
Vanadium (V), ppb	<40	<40	<40	<40	<40	<40	<40	<40
Total PCB, ppb	<0.001	0.26	0.34	0.37	-	-	-	-
Total DDT, ppb	<0.001	<0.001	<0.001	<0.001	-	-	-	-

Table 10 (Continued)

Elutriate Testing
President Roads, Boston Harbor, MA - April 1981

Results of tests performed on: (1) the standard elutriate prepared from one part sediment taken at various sampling locations with four parts water from each sampling location and (2) the virgin water from each sampling location as as follows:

Test Property	Dredge Site Water Location C EW-9-81	Standard Elutriate Designation and Sediment Depth* Used in Preparation Location C GE-9-81		
		R1	R2	R3
Nitrite nitrogen (N), ppm	<0.005	<0.005	<0.005	<0.005
Nitrate nitrogen (N), ppm	0.03	0.03	0.03	0.03
Ammonia nitrogen (N), ppm	0.5	3.0	2.9	3.1
Sulfate (SO_4), ppm	3,470	2,730	2,620	2,740
Oil and Grease, ppm	<0.5	1.0	0.8	0.7
Phosphorus (P)				
ortho, ppm	0.04	0.01	0.03	0.02
total, ppm	0.04	0.04	0.05	0.07
Mercury (Hg), ppb	0.5	<0.5	<0.5	<0.5
Lead (Pb), ppb	17	22	12	13
Zinc (Zn), ppb	145	25	70	15
Arsenic (AS), ppb	<1	1.3	1.3	<1
Cadmium (Cd), ppb	14	5	<0.5	<0.5
Chromium (Cr), ppb	<4	<4	<4	<4
Copper (Cu), ppb	10	<2	<2	<2
Nickel (Ni), ppb	30	10	10	<5
Silver (Ag), ppb	<80	<80	<80	<80
Vanadium (V), ppb	<40	<40	<40	<40
Total PCD, ppb	-	-	-	-
Total DDT, ppb	-	-	-	-

*R_1, R_2 and R_3 - Replicate determinations
**Surface grab sample only

3. Impact on Organisms

a. Physical Effects

i. Removal of Benthos

The benthic organisms associated with the sediments to be dredged will be destroyed during the dredging process and removed from the site. The affected organisms are listed in Appendicies B and C and include benthic invertebrates such as polychaetes, amphipods and shrimp. These serve as a source of food for crabs and finfish. More motile forms such as fish would avoid the work area and should not be seriously affected. The loss of forage for predators would be temporary because the dredged areas would be recolonized within a few months after dredging. Some of the more opportunistic species such as Capitella and Nepthys would be the first recolonizing organisms. The removal of contaminated sediments may provide more suitable habitat for organisms such as amphipod and bivalves.

ii. Turbidity

Increased suspended sediments in the water column would decrease light transmittance through the water column. This and burial of benthic algae would decrease general photosynthetic activity in the dredged areas. This effect would be temporary and entirely local. The areas affected by dredging provide a small portion of the habitat available to widely distributed populations.

Most of the adult benthic organisms are polychaete worms associated with fine sediments which are continually disturbed by harbor activities. The turbidity generated from dredging should have an imperceptible impact on organisms such as these. The polychaete worms are primarily deposit feeders. It has been found that their feeding activity reworks fine grained-sized sediments, producing a granular surface which is easily resuspended by low velocity currents (Rhoads and Young, 1970). Therefore, these organisms are able to withstand extended periods of turbidity.

It would appear that filter feeding organisms such as bivalve molluscs would be more sensitive to increased suspended solids because of the nature of their feeding and respiratory mechanisms. However, review of the literature indicates that bivalves exhibit low mortality due to increased suspended solids from dredging operations (Stern and Stickle, 1977). In addition a report done for the Massachusetts Department of Natural Resources (1973) found filter-feeders such as quahogs, soft-shelled clams, and Atlantic oysters were not affected by 48- and 96-hour sediment concentrations of 83.2 grams per liter. These values simulate the effects of the worst case turbidity from dredging activities. Therefore, harm to filter-feeders is not likely to occur.

The increased turbidity may be detrimental to sensitive eggs, larvae, juveniles of invertebrates or fishes in the dredgings areas. The settlement of suspended sediments may also bury these life stages. For example, demersal finfish eggs such as those of the winter flounder (Pseudopleuronectes americanus) cannot withstand burial under more than a few millimeters of material. Life-sustaining functions occur at the egg surface and water interface. Burial by sediment impedes gas exchanges and traps toxic materials next to the egg, eventually killing the organism.

Some impact to the resident seasonal finfishes of the Mystic and Chelsea Rivers area may occur. Dredging within the river channels may inhibit organisms such as winter flounder and ocean pout from swimming upstream past the operation. Seasonal movements of anadromous species such as alewives and smelt may also be affected. However, the relative lack of significant upstream spawning habitat for these species compared with other harbors, rivers and coastal inlets in the region reduces the need for measures to mitigate impacts.

b. Chemical Effects

The chemical effects on organisms in the dredging areas would be minimial. The elutriate tests indicated that the concentration of heavy metals release to the water column (i.e., available to aquatic organisms) were below the water quality criteria established by EPA. The elutriate test did indicate release of PCB's above the 24-hour average standard. However, as stated above, releases from clamshell dredging would be lower than those indicated in the elutriate test. In addition, the release that will occur will be diluted by large volumes of continually flowing water at the dredge sites. If PCB's were accumulated by organisms in the vicinity of the dredging sites, recent studies have shown that the accumulation would be temporary. Arimoto and Feng (1980) found that the PCB concentrations in mussels near a disposal site in New London, Connecticut, increased during disposal operations but decreased soon after disposal operations ceased. Studies in Puget Sound, Washington, where PCB sediment concentration were high beause of a previous spill, showed similar results (Wright, 1978).

B. Impacts Of Disposal

1. The Action of Disposal

The dredged material is released through bottom opening doors in the scows and deposited at the dump site. The movement of sediments through the water column has been described by Gordon (1977). Briefly, upon release from the scow, the dredged material generally descends rapidly to the bottom. The speed of decent and the size of the bottom spreading depends on many factors, including the mechanical properties of the sediment, water percentage of the sediment, depth, bottom conditions, ambient currents, etc. Gordon also indicates that ambient current conditions are important because such a large volume of ambient water is

collected during descent that the material flow will acquire the ambient lateral velocity of the water. Upon impact, a turbidity (density driven) current will be set up which will spread outward until friction forces cause it to halt.

2. Alteration of the Environment

a. Water Quality.

The impacts of the water quality associated with dredged material disposal are a temporary and local increase in suspended solids and sediment contaminants.

i. Turbidity.

Release of the dredged material would create a turbidity plume of fine loose and clumped material into the water column. Studies during disposal at the Boston Foul Area by New England Aquarium (1975) indicated that suspended solids were highest near the bottom of the water column. However, the levels of turbidity did not adversely affect primary production. Gordon (1974) found that only 1% of the total volume of dredged material at a site in Long Island Sound remained suspended in the water column after disposal.

ii. Release of Contaminants

The mixing of the anoxic sediments during descent and impact on the bottom may release nutrients, petroleum hydrocarbons, metal and chlorinated hydrocarbons into the water column. The discussion of potential release of contaminants during dredging (Section A1b) would also apply to disposal. Briefly, elutriate testing indicated worst case potential release of ammonium nitrogen, phosphates, oil and grease, mercury, zinc, lead, arsenic and PCB's. The nutrient releases were marginal which may cause only localized increases in phytoplankton productivity. Metal releases were all within EPA guidelines.

Release of PCB's were above the 24-hour average (0.03 ppb) (EPA 1980). However, this level is a worst case estimate because: (1) a clamshell dredge will be used which will minimize mixing of sediments within the water and (2) dilution by the water column during disposal would probably reduce levels down to acceptable standards. The elutriate test indicated that Station A sediments of the Mystic River showed the highest release of PCB's, 13.2 ppb. Formula "H5" in Appendix H of the EPA/CE guidelines (EPA/CE, 1977) is suggested for determination of the volume of disposal site water necessary to dilute the discharge liquid phase to acceptable levels. Assuming a barge load of 1,500 c.y. and a worst case release of 13.2 ppb into the water column, approximately 452,700 c.y. of water would be required to dilute released PCB's down to acceptable EPA 24-hour average guidelines. In actuality, less would be required since a clamshell dredge would be used.

b. Sediment Quality.

The action of disposal would displace dredged sediment from the harbors to the dump site. This action would not significantly change the present character of the dump site sediment since the area has been used as a dump site for a number of years. The dredged sediment analyses may be compared with the sediment analysis of the Boston Foul Area (New England Aquarium, 1975) (Table 6). The sediment textures of the majority of the harbor and the Boston Foul Area sediments are described as silty clay with the exception of Station A at the President Roads area and Station D in the Chelsea River where silty sands are present. Comparison of contaminant levels indicate that disposal of the harbor sediments would introduce relatively higher levels of oil and grease, mercury, chromium, copper, vanadium and PCB's to the dump site sediments. Other constituents are only moderately higher or lower (nickel) than the Foul Area sediments.

Generally, metals are bound to organic oxides, sulfides, or are adsorbed to or part of the crystalline structure of sediment particles; hydrocarbons are bound to organic particulates and fine sediments. These are generally unavailable to organisms in these forms and, therefore, would not be of concern. Point discharge would mound the harbor sediments so that most of the contaminated sediments would be unavailable in an anoxic sediment environment and would so remain so as long as anoxic conditions are maintained. However, disturbance of the sediment could oxygenate the reduced sediment causing releases of some metals into the water column. PCB's are strongly bound to organic particulates and are mostly insoluble in water. Stirring the particulates could increase its concentration in the water column (Fulk et al., 1975).

Two factors may disturb mounded sediments over the long term, bottom currents and biological activity.

The sediments of the Boston Foul Area have been characterized as fine sediments which are indicative of areas of deposition and low bottom currents. Studies by Schlee and Butman (1974) indicate that, at the majority of sites where currents have been measured in Massachusetts Bay, bottom sediments are in equilibrium with the maximum observed current speed. Thus, it appears that average current velocities (Section IV) at the Foul Area are not great enough to cause significant movement of dredged material deposited there. Acoustic profiling by Tucholke (1972) indicates that tens of meters of fine materials have accumulated in Stellwagen Basin since the Pleistoncene Epoch. It is his opinion that this area acts as a natural sediment sink for fine grained particles. However, winter storm waves could exert enough energy at the bottom to resuspend unconsolidated sediments (New England Aquarium, 1975). Such resuspension would be local and sporadic and probably would be directed in a shoreward direction.

The mound would be recolonized by opportunistic benthic organisms soon after disposal. Rhoads and Young (1970) found that life activity of

these organisms can rework and stir the sediments down to about 10 cm in depth. Such activity could cause minor releases of sediment contaiminants which would be quickly diluted by the bottom currents. Potentially available contaminants down to the 10 cm depth eventually would reach an equilibrium with the water column concentrations. Unless the mound is disturbed, the contaminants below this depth could remain sequestered indefinitely.

3. Impacts on Organisms

a. Physical Effects

i. Turbidity

The increased levels of suspended solids during disposal operations would be short term and localized. The impacts of disposal on phytoplankton were monitored at the Foul Area during disposal operations in 1973 (Martin and Yentsch, 1973). The authors found no evidence to suggest that the natural seasonal fluctuations of phytoplankton were disturbed. The effects of turbidity on benthic deposit feeders, filter feeders, and fish have been discussed in Section A.3. Again impacts would be mimimal and short term.

ii. Sedimentation

The disposal of dredged sediments would bury any benthic organisms at the dump site. Burrowing sediment feeding organisms, especially deep-burrowing forms, would have a better chance of survival than non-motile or less mobile forms living on the surface (Maurer *et al*. 1978). Burying of the more sensitve eggs, larvae and juvenile forms would probably result in death. Large motile forms such as fish or crabs would have a better chance of survival. Recolonization by smaller shortlived pioneering species would occur soon after disposal. Rhoads *et al*. (1978) and McCall (1977) have shown that successions of benthic communities would follow until a climax community of longer lived larger species become established. This would occur provided that the site will not be disposed on again within a few years. Once established, the tubes of many recolonized invertebrates may actually stablize the mound surface (Saila, personal communication). Complete recovery of the benthic productivity, if it occurs at all, would be difficult to predict but may range from 1.5 years (U.S. Navy, 1979) to 11 years as calculated by Saila (1973) provided subsequent dumping does not occur. This may not be true in this case since the Foul Area is a designated dump site.

b. Chemical Effects

The bioassay tests have been developed to measure the potential of toxicity of dredged material to representive organisms. Briefly, appropriate sensitive organisms are subjected to three phases of dredged material likely to cause impacts: the liquid phase which is release from

the pore water of the sediments, the suspended solid phase which is related to fine sediments, and the solid phase which is concerned with the sediment deposition on the dump site sediments. Mortalities of the exposed organisms are statistically compared with organisms exposed to a similar but "not previously dumped on" reference sediment. The details of the test procedures are more fully described in EPA/CE (1977).

The uptake of sediment contaminants by organisms is also of concern. The bioaccumulation test was devised to determine the potential occurance of biological assimilation of sediment contaminants after disposal. The test involves a statistical comparison of the tissue contaminant levels of organisms exposed to the dredged sediment (usually survivors of the solid phase testing) with organisms exposed to a control sediment. The test procedure is also fully described in EPA/CE (1977).

Energy Resources Company has conducted bioassay/bioaccumulation tests for the sediments to be dredged in this project. The sample sites of each dredging area are shown in Figures 1-6. Test reports on each area are available upon request.

Analysis of the test results of all three bioassay phases for all areas indicates that: (1) there was no statistical difference between the mortalites of the test and control organims, or (2) if there was a statistical difference in mortalities, a dilution analysis (Appendix H, EPA/CE 1977) showed that any toxic substances would be diluted to acceptable levels (0.01 of the concentration which causes 50% mortality) within four hours of disposal.

The bioaccumulation test indicates potential uptake of mercury at Station B in the Mystic River, Stations A, C and D in the Chelsea River and Stations A, B and C in the President Roads area. Positive accumulation was only shown in the filter-feeding hard shell clam, *Mercenria mercenaria*. The trace metal cadimum was also accumluated at Stations C and D in the Chelsea River by the marine worm *Nereis virens*. Petroleum hydrocarbons were accumulated by *Mercenaria* at all stations of each dredging area. No accumulation was indicated for PCB's or DDT.

Notwithstanding these results, it appears that the relative level of uptake is not of concern. Tissue mercury concentrations in *Mercenaria* ranged from 0.011 to 0.013 ppm. Such levels are well within the FDA action level of mercury contamination in fish and shellfish (1.0 ppm, FDA, 1978). Cadmium levels in the polychaete, *Nereis*, ranged from 0.088 ppm to 0.094 ppm at Stations C and D in the Chelsea River. FDA levels for cadmium have not been established for aquatic organisms. However, tissue concentrations at the other sites were within the same range (0.072 ppm to 0.094 ppm) and were not statistically significant. Further, *Nereis* exhibited "non-significant" accumulation of cadmium at other New England harbors within a broader range of tissue levels: 0.045 ppm to 0.106 ppm. Thus, the statistically significant tissue levels in *Nereis* at Chelsea Stations C and D are not of concern because the levels are within the range of non-statistically significant results.

The potential biological uptake of petroleum hydrocarbon ranged from 1.9 to 10.1 ppm in clams exposed to the President Roads sediments and 5.1-6.1 ppm in clams exposed to the Mystic and Chelsea River sediments. Although this accumulation was statistically significant, the relative tissue levels may not be of concern. Tissue levels for petroleum hydrocarbon have not been established by the FDA. However, the above tissue concentrations are comparable to baseline levels of most organisms 0.01 ppm to 10 ppm; whereas organisms exposed to petroleum pollution typically contain from 1 to 1,000 ppm (Clark and MacLeod, 1977). In addition, bioaccumlation tests of other New England harbors indicated that tissue levels for the same species ranged from 0.4 to 12.4 ppm with an average of 5.2 ppm and are not statistically significant. Accumulation levels for sediment of this project are within that range.

Studies on uptake of petroleum hydrocarbons indicate that accumulation from contaminated sediments is relatively minor when compared with uptake from water (Disalvo _et al_. 1977; Burns and Teal, 1973). The elutriate test (Tables 8, 9 and 10) indicated that the worst case release of the oil and grease fraction was minimal at best. Disalvo _et al_. (1977) found this to be true for dredged material in general. Thus, the potential uptake as exhibited by the bioaccumulation test would likely be minor. Mounding of the dredged sediments at the disposal site would isolate the majority of contaminants from the invading organisms or potential resuspension after the concentration at the surface sediments reach an equilibrium with the water column. Thus, the extent of the uptake is likely to be minor and short term.

Another major concern is the potential for predators to carry contaminants outside of the disposal area via prey with contaminated tissue. For this to occur on a significant scale, the petroleum hydrocarbon would have to be transferred and magnified through the food chain. There is no evidence to date that this occurs in marine ecosytems for petroleum hydrocarbons. Recent studies by Burns and Teal (1973) suggest that there is no relationship between petroleum hydrocarbon concentration in tissue and an animals position in the food chain. Review of the literature by Conner _et al_. (1979) supports this theory. Therefore, the potential accumulation exhibited by _Mercenaria_, if it were to occur at all, would be localized at the dump site. The lack of utilization of the Boston Foul Area aquatic resources would further reduce the chances of, if any, impact to man.

C. Endangered Species

Disposal during the late spring, summer and early fall months would have a small or immeasurable impact on any endangered or threatened species which may to be at the disposal site during this time. Given the sparseness of the sitings in the affected area, the short time that disposal operations would actually take place, and the small size of the area involved, the potential for encounter is slight. As indicated above, only two whale sitings were made within a 75-square-nautical-mile area

surrounding the disposal site during 1979. The actual time of disposal would involve a total of 20-30 minutes per 24-hour day. This assumes that 4-6 scows would take a maximum of 5 minutes apiece to discharge the dredged material. Disposal studies in Long Island Sound have shown that 99% of clamshell dredged material falls immediately to the sea floor (Gordon, 1974). The total area that would be affected is estimated to be within 250 yards of the dump site buoy, which is approximately 1/160 of 1% of the total area of Massachusetts Bay. Thus, the chance of encountering a species during operation in the affected area would be small.

If an animal is encountered in the disposal area, disposal operations and associated turbidity may physically disrupt the natural movements or feeding activities of the species which happens to be within a 250-yard radius of the disposal site buoy. However, the disruption would be short term and localized.

If an animal is encountered, it is more likely the animal would avoid the disposal activities. Whale movements are closely associated with food species by way of their sonar apparatus. It is probable that any schooling prey species would quickly avoid such activities and draw away their predators with them.

If by chance an endangered species is dumped on during disposal activities, the effects on that organism would be unknown. No studies have been concerned with the effects of suspended dredged material on whales or turtles. Nor are such studies likely to be conducted because of the endangered or threatened status of the animals.

There is some concern for impacts on the food species of the endangered species. Based on the number of sightings in the Stellwagen Bank area, the species mostly likely to be present in the vicinity of the disposal site would be the finback and humpback whales (URI, 1981). Both species feed primarily on the sand lance (*Ammodytes americanus*) which have marketly increased in numbers in the Bank area since 1975 (Meyer *et al*. 1979).

Impacts to the sand lance may be broken down in the three aspects of their life activities: (1) daily activities in terms of schooling and burrowing, (2) their food source, and (3) reproductive habitat.

Most of the daily activites of the sand lance involve either swimming in schools or burrowing in suitable substrate. Impacts to their natural schooling movements are likely to be short term and localized. As mentioned above, the short time that disposal would actually take place (20-30 minutes per day) and the small affected area involved (1/160 of 1% of Massachusetts Bay) would reduce the chances of encounter with a passing school. It is likely that the school would avoid the disturbance of the operations and not be affected because of the high mobility of this species.

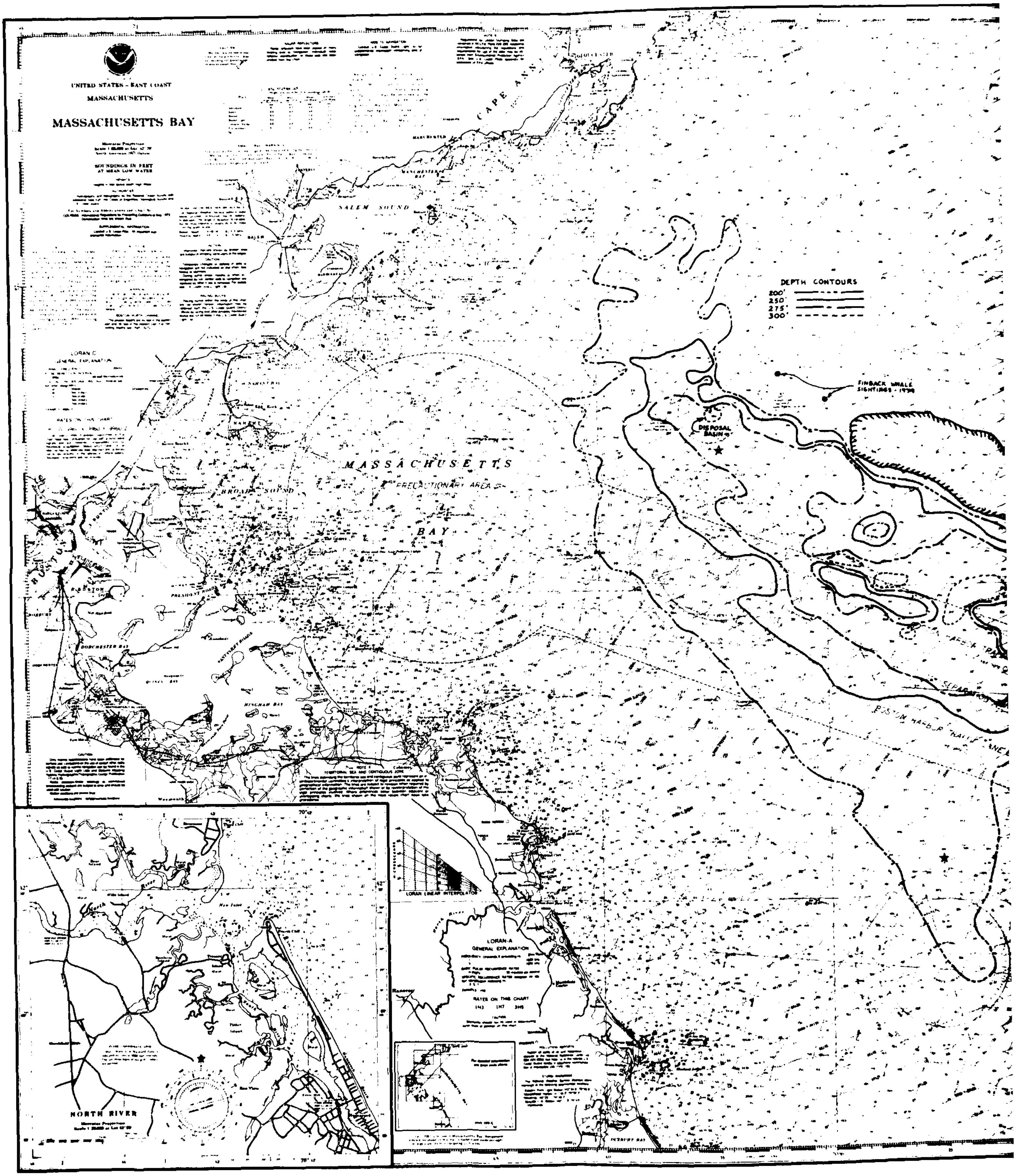
The sand lance also spends a portion of its time burrowing in the sand. It has a marked perference for clean sand and fine gravel substrate associated with a bottom current of about 0.4 - 0.5 knots (c25 cm/sec) (NMFS, personal communication). The entire Boston Foul Area dump site sits in a basin (Figure 8), which is made up of primarily of silty clay (anthropogenic and naturally occurring) with associated currents which average 4-5 cm/sec. This area of sediment accumulation is not considered as potenial habitat for burrowing sand lance. The best habitat for such activity is on the Stellwagen Bank, east of the disposal site. Since the net movement of currents at the disposal site is in a shoreward direction and the 200 foot ridge east of the dump site isolates the site from the Bank area, it is unlikely that the dredged material will move on to the preferred burrowing habitat on the bank.

It is not expected that the sand lance would significantly accumulate sediment contaminants. Approximately 99% of the contaminant-laden sediments would settle to the bottom almost immediately. If any uptake by organisms in the vicinity were to occur, it would occur through the water column. The lack of mixing of the cohesive sediment masses with the water column and the dilution by the water column would reduce any released contaminants to acceptable EPA levels. Studies have shown that release of contaminants during disposal is a short term phenonomen and would return to backround levels soon after disposal (Wright, 1978). Due to the high mobility of schooling sand lance which might be in the vicinity of the area during or shortly after disposal and given the level of release expected, it is doubtful that the organism would be sufficiently exposed to the affected area long enough for any significant accumulation to occur. Since it is unlikely that the sand lance would burrow in the deposited sediment, accumlation from the sediments also would not be of conern.

The food of the sand lance is primarily made up of copepods and other plankton (Meyer _et al._, 1979). The liquid and suspended solid phase bioassay indicated no toxicity to the copepod, _Acartia clausi_, and therefore, should not be a problem.

Few studies on the reproductive habitat of sand lances have been done. However, NMFS (personal communication) has indicated that the usual spawning substrate is again clean sand or fine gravel in about 20 feet of water or less. The Boston Foul Area offers no potential for such habitat.

Therefore, it is concluded that little or no short term impacts and no long term impacts are expected on the sand lance population due to the proposed disposal activities.



UNITED STATES - EAST COAST
MASSACHUSETTS
MASSACHUSETTS BAY
SOUNDINGS IN FEET AT MEAN LOW WATER
CAPE ANN
SALEM SOUND
DEPTH CONTOURS
200'
250'
275'
300'
DISPOSAL BASIN
MASSACHUSETTS
PRECAUTIONARY AREA
BAY
BROAD SOUND
DORCHESTER BAY
HINGHAM BAY
SEPARATION
BOSTON HARBOR
LORAN LINEAR INTERPOLATOR
LORAN-A
GENERAL EXPLANATION
RATES ON THIS CHART
NORTH RIVER

1


DEPTH CONTOURS
200'
250'
275'
300'
FINBACK WHALE SIGHTINGS - 1979
DISPOSAL BASIN
BOSTON HARBOR TRAFFIC LANE INBOUND
SEPARATION ZONE
BOSTON HARBOR TRAFFIC LANE OUTBOUND

FIGURE 8

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Appendix A

GULF OF MAINE TIDAL SYSTEM

STATISTICAL SUMMARY

Parameter	No. of Cases	Mean	Standard Deviation	Mean Plus One Stand. Deviation	Mean Plus Two Stand. Deviation
% Volatile Solids - EPA	553	5.593	5.322	10.915	16.237
% Volatile Solids - NED	393	4.372	4.992	9.364	14.356
% Tot. Vol. Solids - EPA	350	8.776	7.321	16.097	23.418
PPM Chem. Oxygen Dmnd	383	74,541	73,464	148,005	221,469
PPM Tot. Kjeldahl Nit.	382	2,163	2,231	4,394	6,625
PPM Oil & Grease	383	2,532	3,829	6,361	10,190
PPM Mercury	597	0.573	1.210	1.783	2.993
PPM Lead	598	83.2	100.8	184.0	284.8
PPM Zinc	598	134.5	151.0	285.5	436.5
PPM Arsenic	598	6.98	7.66	14.64	22.3
PPM Cadmium	597	3.12	6.25	9.37	15.6
PPM Chromium	597	112.0	225.4	337.4	562.8
PPM Copper	591	83.2	129.4	212.6	342.0
PPM Nickel	598	36.3	27.7	64.0	91.7
PPM Vanadium	598	60.9	58.9	119.8	178.7
% Total Carbon	165	3.342	2.172	5.514	7.686
% Hydrogen	165	0.692	0.456	1.148	1.604
% Nitrogen	165	0.388	0.363	0.751	1.114
PPB DDT	55	33.67	66.83	100.50	167.33
PPB PCB's	55	613.57	1033.3	1646.87	2680.17

Appendix B

Boston Inner Harbor Species List

Scientific Name	Common Name
ARTHROPODA (Shrimp, Scuds, Crabs, and Lobsters)	
Carcinus maenas	Green Crab
Cancer irroratus	Rock Crab
Corophium sp.	Scud
Crangon septemspinosus	Sand Shrimp
Gammarus duebeni	Scud
Microdeutopus anomalus	Scud
Pandalus borealis	Pandalid Shrimp

Source: Stewart (1968)
Boston Edison (1972)
Marine Environmental Services (August 1976)
Marine Environmental Services (November 1976)
Boston Edison (December 1976 - May 1977)

Appendix B

Boston Inner Harbor Species List

Scientific Name	Common Name
CNIDARIA (Hycdroids, Anemones, Jellyfish)	
Aurelia aurita	
Hydrozoa (unidentified)	
Metridium senile	
ANNELIDA (Segmented and Polychaete worms)	
Capitella capitata	
Capitella gracilis	
Cistenides gouldii	
Eteone longa	
Eteone sp.	
Harmothoe imbricata	
Harmothoe sp.	
Microthamus abberaus	
Nepthys incisa	Shimmy worm
Nereis diversicolor	
Nereis sp.	
Nereis succinea	
Nereis virens	Clam worm
Ophelia sp.	
Pharyx acutus	
Phloe minuta	
Phyllodoce groenlandica	
Phyllodoce maculata	
Phyllodoce mucosa	
Polydora ciliata	
Polydora hamata	
Polydora ligni	
Polydora sp.	
Polydora websteri	
Scolelepis squamata	
MOLLUSCA (Clams and Snails)	
Crepidula fornicata	Slipper limpet
Crepidula plana	Slipper limpet
Mya arenaria	Soft-shelled clam
Mytilus edulis	Blue mussel
Nassarius obsoletus	
Tellina sp.	Tellin or Sunset shell

Appendix C

Boston Outer Harbor Species List

Scientific Name	Common Name
CNIDARIA (Hydroids, Anemones, Jelly fish)	
Abietinaria abietina	
Bougainvillia (superciliaris)	
Cerianthus borealis	
Edwardsia leganse	
Thuiaria (similis)	
RYNCHOCOELA (Nemertean worms)	
Amphiporus sp. B	
Cerabratulus sp.	
Tubulanus sp.	
ANNELIDA (Segmented or Polychoete Worms)	
Ampharete acutiferons	
Ampharete acutiferons (juvenile)	
Amphitrite cirrata	
Cariidea jeffreysii	
Capitella capitata	
Cirratulid sp.	
Eteone longa	
Eteone sp.	
Euchone rubrocincta	
Harmothoe imbricata	
Heteromastus filiformis	
Lumbrinereis fragilis	
Microphthalmus aberrans	
Myriochele (heerei)	
Nepthys incisa	Shimmy Worm
Nepthys longesetosa	
Nepthys picta	
Ninoe nigrippes	
Paronis gracilis	
Pectinaria gouldii	Ice Cream Cone Worm or Trumpet Worm
Pherusa plumosa	
Phloe minuta	
Phyllodoce arenae	
Phyllodoce mucosa	
Polydora caeca	
Polydora sp. A	

Appendix C

Boston Outer Harbor Species List

Scientific Name	Common Name
ANNELIDA (Continued)	
Prionospio malmegreni	
Scalibregma inflatum	
Scoloplos acutus	
Spio filicornis	
Spiophanes (bombyx) A	
Stauroneis caeca	
Trochochaeta multisetosa	
MOLLUSCA (Snails and Clams)	
Cerastoderma pinnulatum	
Hiatella arctica	
Tellina agilis	Tellin or Sunset Shell
ARTHROPODA (Shrimps, Scuds, Crabs, and Lobsters)	
Calanus finmarchius	
Centropages sp.	
Crangon septemspinosus	Sand shrimp
Diastylis quadrispinosa	
Diastylis sculpta	
Diastylis sp.	
Edotea acutus	
Eurystheus sp.	
Halcarus sp.	
Haploops setosa	
Leptocheirus pinquis	
Leucothoe spinicarpa	
Loxoconcha guttata	
Macrosetella sp.	
Micropterus sp.	
Nymphon grossipes	
Orchomonella groenlandia	
Photis macrocoxa	
Pleusymtes glaber	
Stenopleustes inermis	
Unicola irrorata	
ECHINODERMATA (Starfish, brittle stars, sea urchins and sea cucumbers)	

Source: Stewart (1968)
New England Aquarium (1972)

Appendix D

Boston Inner and Outer Harbors Finfish Species List

Scientific Name	Common Name
Alosa pseudoharengus	Alewife
Anguilla rostrata	American eel
Ammodytes americanus	American sandlance
Osmerus mordax	American smelt
Gadus morhua	Atlantic cod
Clupea harengus harengus	Atlantic herring
Scomber scombrus	Atlantic mackerel
Brevoortia tyrannus	Atlantic menhaden
Menidia menidia	Atlantic silverside
Microgadus tomcod	Atlantic tomcod
Lepomis macrochirus	Bluegill
Pomatomus saltatrix	Bluefish
Alosa aestivalis	Blueback herring
Peprilus triacanthus	Butterfish
Cyprinus carpio	Carp
Tautoglabrus adspersus	Cunner
Brosme brosme	Cusk
Apeltes quadracus	Fourspine stickleback
Myoxocephalus aenus	Grubby
Urophycis sp.	Hake
Raja erinacea	Little skate
Myoxocephalus octodecemspinosus	Longhorn sculpin
Cyclopterus lumpus	Lumpfish
Fundulus heteroclitus	Mummichog
Pungitius pungitius	Ninespine stickleback
Syngnathus fuscus	Northern pipefish
Macrozoarces americanus	Ocean pout
Pollachius virens	Pollock
Osmerus mordax	Rainbow smelt
Esox americanus americanus	Red fin pickerel
Urophycis chuss	Red hake
Liparis atlanticus	Sea snail
Hemiptripterus americanus	Sea raven
Prionotus sp.	Sea robin
Myoxocephalus sp.	Sculpin

Appendix D

Boston Inner and Outer Harbors Finfish Species List

Scientific Name	Common Name
Merluccius bilinearis	Silver hake
Liopsetta putnami	Smooth flounder
Squalus acanthias	Spiny dogfish
Anchoa hepsetus	Striped anchovy
Morone saxatilis	Striped bass
Fundulus magalis	Striped Killifish
Gasterosteus aculeatus	Threespine stickleback
Cynoscion regalis	Weakfish
Scophthalmus aquosus	Windowpane
Morone americanus	White perch
Merluccius merluccius	Whiting
Pseudopleuronectes americanus	Winter flounder
Raja ocellata	Winter skate
Limanda ferruginea	Yellowtail flounder

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